

(4) PSTIAC-5-Vol-2-Pt-1 AD A 045025 PSTIAC REPORT NO. 5 A BIBLIOGRAPHY WITH ABSTRACTS OF U. S. ARMY ENGINEER WATERWAYS **EXPERIMENT STATION PUBLICATIONS** RELATED TO PAVEMENTS. Volume II REPORT DOCUMENT PAGE DATA . PART I! BULLETINS, INSTRUCTION REPORTS, MISCELLANEOUS PAPERS Marvin P. Meyer W Virginia Dale Pavements and Soil Trafficability Information Analysis Center and Technical Information Center U. S. Army Engineer Waterways Experiment Station P. O. Box 631, Vicksburg, Miss. 39180 17 Aug # 177 Approved For Public Release; Distribution Unlimited Prepared for U. S. Army Materiel Development and Readiness Command 5001 Eisenhower Avenue Alexandria, Va. 22333 Under Project No. 1E865803M761405 409 294 JB

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AGSTRACT			
The purpose of this appendix i	e to furnish installat	ion instructi	ione for placement o
the XM19 special surfacing mat			
XM19 mat. (The XM19 special s	urfacing is placed onl	v in those cr	ritical areas of a
runway which are identified as			
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for reuse, and determination o			
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This manual provides information and guida maintenance of membrane-enveloped soil lay			
the theater of operations (TO). It is not			
defined herein. replace the conventional m			
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available. However, in the absence of con runway base can be built from purely fine-			
type construction described herein.	grained soll.	s waring cit	e tecimiques of mot
KEYWORDS: Airfields; Base courses; Membra	ne enveloped	somi layer	
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This manual provides instruction and guidance for the design, construction, and maintenance of a landing mat overlay that can be built over a smooth but inadequate strength pavement or over a deteriorated landing mat or pavement surface in order to provide a suitable landing facility for the operation of tactical aircraft.

KEYWORDS: Landing mats; Overlays (Landing mats)

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This report presents a method of rapidly	assessing the	ability o	f an are	a to support
aircraft operations. The method involves				
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This instruction report present and classification of used panels of MoAl,			
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cases in which the used mat is not suitable			
secondary uses are presented.		La barrac.	ing, baggebood
KEYWORDS: Landing mat recovery an	d reuse: I	anding	mats
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Engineering tests have been conducted at WES to determine methods of repairing damaged subgrades beneath landing mats by grouting. Use of portland cement grout consisting of portland cement, CaCl2, water, and filler is effective to a limited extent. The grout can be pumped through 1-in-diam holes drilled into the mat by use of a satisfactory grout pump. Suggested equipment includes a truck, concrete mixer, air compressor and pneumatic drill, grout pump, and a water truck.

KEYWORDS: Grouts; Landing mat maintenance; Subgrades

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density values for a wide variety of mater nuclear equipment and a better understandi led to increasingly widespread use of nucl work. This report describes surface-type test methods used for making shallow-depth place on soil and soil-aggregate mixtures. density test using a properly operating nu bration curve will yield test results slig density tests. The factory moisture calib and adjusted (if necessary) for each mater to perform than conventional tests and requentity and moisture test result.	ials. Recome of the man of the ma	ent advances nuclear primin earth coruipment, promand density al, a 6-in. and an up-tromand the tronger of the theory, however, the nuclear nuclear the nuclear nuclea	s in the design of neiples involved have nstruction control ocedures, and various determinations in direct transmission to-date factory cali- e of conventional , must be checked ear test is simpler

KEYWORDS: Nuclear equipment; Nuclear methods; Soil aggregates; Soil density measuring devices; Soil moisture measuring devices; Unit weight determination; Water content determination

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Final report				
5. AUTHOR(S) (First na	me, middle initial, last name)			
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FOR FORWARD AREA OPERATIONS		Final Report
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Construction control	Soil stabiliza	ation
Construction equipment		
Expedient construction		
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The purpose of this instruction reof native soil and aggregate materoads, airfields, heliports, and of operations (TO). Procedures as in evaluation or identification of improving the existing physical pathey will be suitable for constructions.	rials for the ex storage areas in re presented to f the soil and i roperties of the	pedient construction of forward areas of a theater aid the military engineer n selecting methods of native materials so that

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20. ABSTRACT (Continued)

help the engineer select the type and quantity of additive required if chemical stabilization is used. The methods considered in this report for improving the physical properties of low-quality materials are mechanical and chemical stabilization and waterproofing techniques. Information is also given to help in the selection of the appropriate construction equipment for a particular operation. Detailed construction procedures are outlined for the various types of stabilization.

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7. AUTHOR(*) Malcolm P. Keown Judith A. Parks Jack K. Stoll		8. CONTRACT OR GRANT NUMBER(*)	
9. PERFORMING ORGANIZATION NAME AND ADDR U. S. Army Engineer Waterways Exp Mobility and Environmental System P. O. Box 631, Vicksburg, Miss.	periment Station ns Laboratory	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 4A062103A859, Task 05, Work Unit 013, and 4A162121AT31, Task 02, Work Unit 02	
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16. DISTRIBUTION STATEMENT (of this Report)

Distribution limited to U. S. Government agencies only; computer program documentation; June 1975. Other requests for this document must be referred to U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., ATTN: WESFE.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, If different from Report)

18. SUPPLEMENTARY NOTES

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Airfield site selection

Site investigation

Airfields

Computer programs

Evaluations

Instructions are provided for the use of a set of related computer programs that collectively represent an automated procedure for airfield site evaluation. Properly used, this set of programs permits evaluation of potential airfield sites in terms of geometry and construction time and cost. Instructions for the collection of the required input data and arrangement of these data into the correct computer input format are provided. The quantity of input data to be collected by the user is minimized by the inclusion of several (continued)

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20. ABSTRACT (continued).

tables from which much of the data can be obtained. The output data include relevant airfield geometric parameters and time and cost estimates for the site preparation and runway surfacing phases of airfield construction. These data are interpreted to aid the user in the decision-making process. A discussion of error messages is included to assist the user in eliminating problems related to input data.

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Surface treatment (Roads)		
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This report was prepared to aid the structing slurry seals. The report seals application and discusses mat	facilities engi- identifies the	potential areas of slurry
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slurry seals. A summary of a recom	mended laborator;	y design method for propor-
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7. Author(*) Judith A. Parks		8. CONTRACT OR GRANT NUMBER(*) 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
U. S. Army Engineer Waterways I Mobility and Environmental Syst P. O. Box 631, Vicksburg, Miss	Experiment Station tems Laboratory	Project No. 4A162121AT31, Task 02, Work Unit 02 and No. 1T162112A528, Task 02, Work Unit 02	
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Volume I--Description and Instructions for Use of Computer Programs Volume II--Listings of Computer Programs

19. KEY WORDS (Continue on reverse elde If necessary and identify by block number)

Aircraft landing areas Mathematical models
Airfield site selection Site selection
Computer programs

Helicopter landing zones

20. ABSTRACT (Cauthous on reverse side if recovery and identify by block number)

This report contains instructions for operating a model that is an automated procedure for evaluating designated sites as helicopter landing zones. The model is comprised of three independent computer programs run sequentially.

Program 1 (FTHEL) evaluates the site in terms of generalized conditions (Continued)

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20. ABSTRACT (Continued).

of slope, microrelief, and soil strength as related to the requirements set by certain characteristics of the helicopter that is to land. The program determines whether the site can provide a full-touch zone, a skid-touch zone, a nontouch zone, or no landing zone at all, and computes the minimum departure angle for the specified helicopter if a landing zone is possible.

Program 2 (FTJPRH) is an automated mathematical procedure for predicting the size and shape of a clearing in a forested area by considering blast forces from a bomb explosion, tree stem strength, stem diameter, and distance from ground zero (GZ), the center of the explosion. The clearing is described by a vegetation profile of tree remnant height versus the distance from GZ.

Program 3 (FTJPHL) of the model is an automated procedure for evaluating a clearing by estimating how many trees must be removed from a clearing produced by a high-yield, air-dropped munition in order to use the clearing as a full-touch helicopter landing zone. The output is the number of tree remnants that must be removed to satisfy the landing requirements of a specified helicopter.

All three computer programs were designed and written for use on a Honeywell G-635 computer system equipped with extensive time-sharing capability, coded in FORTRAN language, and run in conversational mode by means of a conventional teletype terminal. Maximum core storage for any one program is 10K words.

This report is intended to serve as a guidebook for the individual responsible for running the programs and requires a working knowledge of computer techniques and terminology and various methods pertinent to data processing.

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This investigation is one	of a series for use in a o	comprehensive study of flexible
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The explorations conducted by the Waterway sisted of three test pits and six auger ho along the center line of the proposed runw terminations were made in the test pits at underlying gravel. Mechanical analysis te materials. The results of these tests are	les. These cay. In-place the surface sts were per	exploration CER test of the to	ns were located s and moisture de- psoil and on the
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the lebonstowy and in the event the tar-	rubber blends app	eared	promising, to estab-	
light design emiteria and to develop desi	on test procedure	s for	determining optimum	
hinden contents The current design crit.	eria and test pro	cedure	s were established	
for penetration-grade-asphalt hot mixes a	nd, being entirely	y empi	rical, may be ap-	
plicable to such mixes only. For this reand test procedures for tars and rubberiz	ed tars is necess	arv.	Also, new design	
criteria must be developed for each major	change in wheel	contac	t pressures.	
KEYWORDS: Flexible pavement design (Airf	ields); Jet blast	resis	stant materials; Jet	
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. ABSTRACT	Waching	ton, D. C.
The problem is to determine when having a CBR greater than that will permit a reduction in the criteria. The degree of protes should be evidenced by the amongrade material that occurs under sults published for a number of and tested. For this reason deanalysis.	required for the prope thickness required for ction provided the subg unt of vertical movemen er load. Deflection ha f instances in which te	r design of a pavement layer that layer by present design grade by the covering layers it or deflection of the subsequences been measured and the rest sections were constructed
KEYWORDS: Base courses; Calif	ornia Bearing Ratio tes	sts; Pavement deflection; Stress
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It was desired in this present study to de test procedure simulates the prototype fro A study was made, by microscopic examinati penetration of hot asphalt into different porosity and void sizes under varying temp included samples from an actual pavement, impregnated specific gravity test procedur certain other combinations of temperature pared by the petrographer who made the examppendices A and B.	m the standp on of cut se mineral aggr cratures and samples prep e, and sampl of aggregate	oint of as ctions, of egates of condition ared accor es prepare and aspha	phalt penetration. the degree of varying degrees of s of mixing. These ding to the bulk- d according to lt. Reports pre-

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KEYWORDS: Aggregate tests; Bitumens; Liquid asphalt; Specific gravity; Voids

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EFFECT OF EXHAUST OF F-100A AIRCRAF TESTS AT DAVIS-MONTHAN AIR FORCE BA	T ON AIRFIELD PAVE SE, ARIZONA	MENIS; SUMMARY OF RESULTS	S OF
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KEYWORDS: Exhaust blast effects; Flexible pavements; Rigid pavements; [Davis-Monthan Air Force Base, Tuscon, Arizona; F-100 Aircraft]

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to obtain data regarding the condi in a comprehensive study of payens	of field and laboratory investigations conducted ition of pavement at Turner Air Force Base for uent behavior under traffic. Turner Air Force Banish information for use in the portion of the ment base courses.
KEYWORDS: Base courses; Flexible	e pavement performance and evaluation (Airfields Air Force Base, Albany, Georgia]
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3. ABSTRACT			
A series of condition survey:	s of airfields having	soil-cement cor	struction was in-
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Air Force Base was one of the	e fields tested in the	inproving such ma	terials. Moody
would furnish information as	to the behavior of	coil-coment baco	courses under
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	xible pavement perfo Base, Valdosta, Geor		ation; Soil cement;
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	RAPHOSPHATE TO VICKSBURG LEAN CLAY
6. DESCRIPTIVE NOTES (Type of report and inclusive da	sico)
S. AUTHORISI (First name, middle initial, last name) Woodley, Woodland G.	
September 1953	74. TOTAL NO. OF PAGES 75. NO. OF REFS
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4. DESCRIPTIVE NOTES (Type of report and Inclusive dates)		
5. AUTHOR(3) (First name, middle initial, last name)			
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KEYWORDS: Exhaust blast effects; Jet blast resistant materials; Jet fuel resistant materials; Jet fuel spillage (Pavements); [Hunter Air Force Base, Georgia]

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13. ABSTRACT	1 20001010		
The objective of this study is to esta	hlish a simple	index to th	e construction effort
that is required to build airfields in	theaters of o	perations.	Such an index will
provide aircraft designers with a rela	tive concept o	f the airfie	eld construction
problems precipitated by proposed airc	rait modificat	ions.	
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4. DESCRIPTIVE NOTES (Type of report and Inclusive d			
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13. ABSTRACT			
The purpose of the study was to e	valuate the performan	nce of a Lo	ckheed Neptune P2V
plane on unprepared landing strip	s. The P2V is a Nav	r. single-w	heel-assembly (tri-
cycle landing gear) plane which h 20:00 x 20 tires on the main land	as been modified by	the Air For	ce. It is equipped with
pressure of about 50 psi with a g			
carried by each main wheel. The	Air Force is consider	ring the us	e of this plane for
one landing and take-off operatio studied are minimum runway length			
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KEYWORDS: Landing strips; Unsur	faced runway perform	ance and ev	aluation; [Eglin Air
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KEYWORDS: Airfields; Deflection; Landing mats

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1. REPORT TITLE			
TESTS ON AN ABSORPTIVE ACGREGATE TO S IN COMPACTED BITUMINOUS PAVING MIX	STUDY EFFECT OF A	ESORPTION AI	ND GRADATION ON VOIDS
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
S. AUTHORIS) (First name, middle Initial, last name) John L. McRae			
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The Indiana mix typified two current related problems of proper specific on voids. It appeared desirable to limited tests as a part of the bitum were provided by Professor Woods, and	gravity and voids procure samples o inous mix design	of this mater research wo	ffect of gradation rial and conduct rk. The aggregates
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4. DESCRIPTIVE NOTES (Type of report and inclusive	dates)		
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KEYWORDS: Asphalt mix design; Bitumens; Hot mix; Voids

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S. REPORT TITLE				
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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)				
6. Authorits (First news, middle initial, last news) George R. Kozan				
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3. ABSTRACT				
The purpose of this review is to summari lignin and chrome-lignin processes for s studies are summarized herein as backgro review was the extensive research conduc Research and Development Laboratories co of lignin agents as well as major equipm gestions for further work, both in the 1	oil stabilization material, ted by Cornel ontract. The ment deficience	tion. Altho the primary l University capabilities ties are disc	bugh many earlier basis for this under Engineer and limitations cussed. Sug-	

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4. DESCRIPTIVE NOTES (Type of report and Inclusive dates)			
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Calcium acrylate monomer when added to a soil in the presence of water and an appropriate catalyst polymerizes, holding the soil grains in a cross-linked network of bonds. Data show that good stabilization can be achieved by this process on a wide range of soils. A soil stabilized in this manner is weakest and most flexible at high water contents. Large-scale tests indicate that the limitations of presently available construction equipment reduce the effectiveness of the chemical in field treatment. However, the results are considered sufficiently promising to warrant further study of stabilizers of this type.

KEYWORDS: Chemical soil stabilization

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s. AUTHORIS: (First name, middle initial, last name) George R. Kozan John D. Stouffer			
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s. Authoris (first name, middle initial, last name) George R. Kozan William B. Fenwick			
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This report presents the results of field tests of a new type of compaction apparatus designated the impact compactor. The tests were made on lean clay soil for which compaction data obtained in previous studies with rubber-tired and sheepsfoot rollers are available. The purpose of the study was to observe the behavior of the impact compactor and determine its effectiveness in producing high densities and strengths in the lean clay soil. The study consisted of (a) construction of 11 test lanes, using three different models of the compactor, (b) testing of the compacted material for water content, density, and in-place CBR, and (c) comparison of the compaction and CBR data developed with the impact compactor with laboratory data and field data developed with other types of compacting equipment.

KEYWORDS: Compaction equipment; Impact compaction

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KEYWORDS: Airfield construction; Landing mat construction; Unsurfaced airfields; [Camp Campbell, Clarksville, Tenn.; Eglin Field, Valpariso, Fla.]

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The tests described herein were authorized by the Office, Chief of Engineers, in letter dated 14 September 1954, subject "Jet-Fuel Resistant Coating," to determine the suitability of Congercote as a protective seal for asphaltic-concrete payment subjected to jet-fuel spillage. The material was first called "Weathercote" but its name was changed by the manufacturer, M. Weaver Company of Cincinnati, Ohio, to "Congercote." Tests were also conducted on this material to determine the effects of high-pressure-tire traffic both inside and outside the fuel-spillage areas.

KEYWORDS: Jet fuel spillage (Pavements); Protective coatings; Seal coats

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The mobile materials laboratory M-2 is a self-contained soils, bituminous, and concrete testing laboratory mounted within an insulated semitrailer van which can be towed by a 5-ton or larger truck-tractor. The van contains a 10-kw engine generator, an air-conditioning unit, and a heating unit. The laboratory without dolly weighs 26,640 lb; the dolly weighs 2,600 lb. The objective of this test is to determine the operational suitability of the mobile materials laboratory. The test will encompass the following: (a) Phase I, transportability, mobility, and maneuverability; (b) Phase II, adequacy of testing equipment; (c) Phase III, adequacy of van design and accessory equipment; (d) Phase IV, adequacy of field reconnaissance kits; (e) Phase V, adequacy of electronic interval timer.

KEYWORDS: Field laboratories

13. ABSTRACT

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Placement of the wearing surface on the southwest end of the runway was begun on the morning of 2 May 1955. At the beginning of paving operations, the surface texture was comparatively rough and mat density lacked uniformity. As a result of several conferences of representatives of the Office, Chief of Engineers, South Atlantic Division, Jacksonville District, and the Waterways Experiment Station some changes in adjustments of the spreader and in the method of rolling, and slight variations in gradation were made which improved both the surface texture and mat density. These changes are discussed in detail in appendix A.

KEYWORDS: Jet fuel spillage (Pavements); Rubberized-tar pawements; [Homestead Air - Force Base, Florida]

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Recent studies of the effects of large organic cations on altering certain physical properties of soil have indicated the potentialities of these compounds as soil stabilizing agents. This investigation was conducted to gain further information on the suitability of such additives for use by the Corps of Engineers. Laboratory tests were made of Vicksburg loess soil treated with various amounts of a quaternary ammonium salt to determine moisture adsorption, density, and strength of the treated specimens. Test results showed that the air-dried strength of the treated soil was significantly less than that of the untreated soil; however, the rewet strength, water absorption, swelling, shrinkage, and slaking characteristics were improved. An optimum admixture for maximum effectiveness of the additive was found. The necessity for appreciable drying of the treated soil before any improvement in soil stabilization is effected precludes the use of this admixture in the field. However, the improvement realized in many soil characteristics suggests that further investigation of fatty quaternary ammonium compounds of this type as soil stabilizers might be desirable. KEYWORDS: Chemical soil stabilization; Loess		
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The cooperative study reported herein is a specific gravity of aggregates for bitumin has been engaged in for several years. So in this report for background information, the cooperative tests engaged in by the Fl and division laboratories for the purpose that had already been established and maki as a result of the cooperative tests. Fro and best procedure to use as standard for asphalt for the test fluid without regard nating the external vibration which is now determinations should check with 0.04.	nous pavement one of the position of the position of evaluating any modification these test wo to source,	ts that the revious results aper is main ment Laborat ng the proper fications thats, it appeared by and 2-min he	Corps of Engineers alts are included alty concerned with tory and nine distripsed test procedure that appeared necessared that the simple 85-100 penetration and stiring, elimi-
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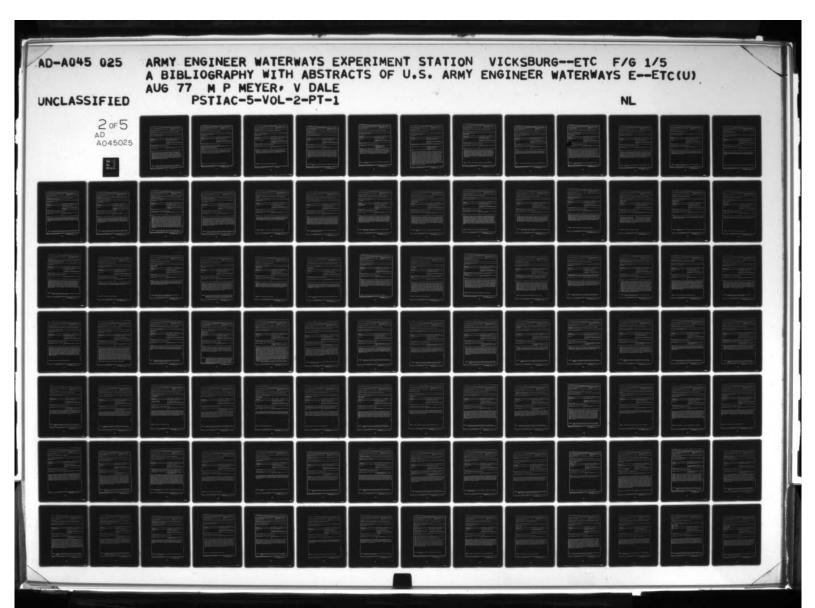
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Visual observations have been recorded on specimens of bituminous pavements exposed to the weather at the Waterways Experiment Station for periods of four months to eight years. The effects of weathering on durability of pavement specimens, in which composition or certain elements in the specimen preparation procedures were varied, were observed. The following were studied as to their effect on the specimens: (a) varying penetration of asphalt, (b) varying crudes from which the asphalts were refined, (c) method of refining asphalts, (d) aggregate gradation, (e) compaction, (f) asphalt content, (g) compaction temperature, (h) type of bitumen, and (i) type and quantity of filler. Cracking of the specimens has been the most prevalent effect of weathering and aging. In some instances, the specimens have deformed because of coldaflow and lack of lateral support. Spalling and erosion have occurred on specimens aged for long periods. There is evidence that certain properties such as bitumen content, gradation of aggregate, and compaction effort are related to durability of pavements; however, it is not believed that the weathering data included in this report are exhaustive enough to warrant final conclusions at this time.

KEYWORDS: Flexible pavements; Pavement deterioration; Weathering effects

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ID. ABSTRACT			

These tests have indicated a very serious deficiency in density of this pavement which could alone cause failure through surface deterioration if moisture and dirt were present during traffic. Water was found in the asphalt from the contractor's storage tank; if this contamination was present, possibly caused by a leaking steam coil, then it would definitely contribute toward stripping and surface deterioration. There is some evidence of overheating of the aggregate. It is recommended that steps be taken to insure use of proper equipment for heating the asphalt and proper control of aggregate-drying operation. It is further recommended that steps be taken to insure obtaining adequate density in the pavement. If these steps are taken, these materials should make a satisfactory pavement.

KEYWORDS: Asphalt deterioration; Flexible pavement performance and evaluation (Airfields); [Harmon Air Force Base, Stephenville, Newfoundland, Canada]

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Vicksburg, Mississippi			
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MOISTURE CONDITIONS UNDER FLEXIBLE AIRFI	ELD PAVEMENT	rs .	
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6. AUTHORIS: (First name, middle initial, last name)			
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tions Division, No. SM1, Jan. 1957, Pape No. 1159	er ·		
NO. 1199			
Investigation of conditions under paveme	nts on 13 ai	rfields ove	r period of several
years indicates that base course and sub			
after about 2 yr.; moisture contents in			
to rainfall, contrary to those at 30 in.			
for nonplastic, but about right for plas	tic material	s.	
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KEYWORDS: Base courses; Flexible pavement	ents; Soil mo	oisture; Sub	grades

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U. S. Army Engineer Waterways Experi	lment Station	Unclassified
Vicksburg, Mississippi		26, GROUP
REPORT TITLE		
A STUDY OF THE EFFECTS OF H-21 HELIC	COPTER OPERATIONS	ON FLEXIBLE PAVEMENTS
DESCRIPTIVE NOTES (Type of report and inclusive dates)		
AUTHORIS (First name, middle initial, last name)		
W. K. Kastner		
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EXPERIMENTS IN DESTABILIZING SOILS WITH CHE	MICALS			
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A. B. Thompson				
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13. ABSTRACT				
The tests described herein were conducted as an agent for reducing the usefulness of pilot tests were conducted on flexible pave the bentonite, to select the type of granuand to determine quantities to be used in then performed on blends of bentonite and ability of the mixture to absorb moisture not enough moisture was absorbed to produce and bentonite were also tested and it was the plasticity index of the soil. For the flexible pavement, bare soil, and turf were lated bentonite. The material was moistent was determined by traffic and skid tests. as thickly as considered reasonably possibility flexible pavement, bare soil, or turf suffice. 1/2-ton truck, or a 1/2-ton truck. Limitesults. Removal or neutralization of the and washing or shoveling was found to effective the soil of the soil or the soil or shoveling was found to effective the soil of the soil or shoveling was found to effective the soil of the soil or shoveling was found to effective the soil of the s	eirfield and ement and tur lated bentoni full-scale te deliquescent from the air e stickiness. found that th full-scale te treated wit ed and its ef The tests she for a largiciently to i ted tests mad bentonite wa	roadway su f to develo te best sui sts. Labor materials t and become Mixtures te bentonise tests, exist th varying of fect on mov towed that b the area, will mmobilize te of Aqua of tests attempted	urfaces. Small-scop methods of applited for the purporatory tests were to determine the plastic; however, of a lean-clay so a admixture increating surfaces of quantities of grantement of vehicles bentonite, applied 11 not destabilize a light tank, a Gel produced the set by different met	eale ying sse, iil ased ii- ssame
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FIELD COMPACTION TESTS WITH JAY (M	ODEL J-12) PLATE-TY	PE VIBRATOR	Y COMPACTOR
. DESCRIPTIVE NOTES (Type of report and inclusive d	*****		
. AUTHORISI (First name, middle initial, last name)			
Cecil D. Burns			
Hansen, Raymond			
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13. ADSTRACT		
A number of military airfields in the Uni	ted States ha	ave been constructed with soil-cen
base courses. Ar investigation of severa	l of these f:	ields was made by the Waterways Ex
periment Station to determine the behavio	r of these ba	ase courses under the conditions t
which they had been subjected. This pape	r presents th	he results of the investigation.
Studies were made at the following airfie	lds where a	portion of the paved facilities we
constructed with soil-cement base courses	: Turner AF	B. Albany, Georgia; Moody AFE, Val
dosta, Georgia; West Palm Beach AFB, West	Palm Reach.	Florida: Hot Springs, Arkansas, M
nicipal Airport and Adams Field (Little R	look Arkansa	s Municipal Airport): Clovis AFB.
Clovis, New Mexico; and Edwards AFB, Muro	California	a Detailed visual inspections We
Clovis, New Mexico; and Edwards AFB, Muro	lebenator: t	acts were performed at West Palm
made of all the pavements, and field and	laboratory to	esus were performed at west falls
Beach, Moody, and Turner AFB's and Hot Sp	rings munici	par arreort.

Unclassified
Security Classification

SOURCE SON AND USE.

KEYWORDS: Base courses; Flexible pavement performance and evaluation (Airfields); Soil cement; [Adams Field, Little Rock, Ark.; Clovis AFB, Clovis, Mexico; Edwards AFB, Muroc, Calif.; Moody AFB, Valdosta, Ga.; Municipal Airport, Hot Springs, Ark.; Turner AFB, Albany, Ga.; West Palm Beach AFB, West Palm Beach, Fla.]

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This report presents results of field tests of the Duo-Pactor, a soil compactor that incorporates a steel-wheel roller in conjunction with a rubber-tired roller. Tests were made on a lean clay soil and a crushed-limestone base course material to evaluate the Duo-Pactor's compacting capabilities and determine its mechanical adequacy. Test results indicated that the Duo-Pactor did not produce densities in the lean clay material as high as those produced by a standard 50-ton rubber-tired roller. Slightly better compaction was obtained when both the rubber-tired and steel rollers were used. The degree of compaction obtained in the lean clay by eight coverages of the Duo-Pactor was considerably less than the 100% modified AASHO requirement; however, the densities obtained in the crushed-limestone material did meet this requirement. No structural or mechanical deficiencies were apparent; however, the period of operation was too short to determine fully the mechanical adequacy of this compactor.

KEYWORDS: Compaction (Soils); Rubber tired rollers; Steel wheel rollers

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at Simmons Army Airfield, Fort Bragg, North	Carolina, c	ontaining a	sbestos fibers, which
showed great resistance to both jet fuel an	d heat. The	objectives	of the study were to
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asbestos fibers. The study consisted of:			
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13. ABSTRACT				
A visual survey of the pavements	was made in Augus	st 1956 and at tha	t time all runways and	
taxiways seemed to be performing satisfactorily under the loads imposed. Some minor cracking and rutting were noted on the blast pad located at the north end of the NE-Sw runway.				
The seal cost on the runways and taxiways appeared to be slightly rich, and some bleeding				
was occurring in the areas most used. Tire printing was evident in these areas. Some softening of the parements as a result of oil spillage was noted on parts of the apron; how-				
and had been applied to absorb the excess oil. No detrimental effects were noted				
from the smilling of int funl: on	ly one let plane	(T-33) was locate	d at the base at the time	
of this inspection. In general,	the primary faci.	lities were consid	ered to contain no de-	
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John L. McRae		
Charles R. Foster		
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3. ABSTRACT A Visual inspection of Lawson Fiel			
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constructed since 1956 (access aprons and was flexible pavement on the runways and taxiway			
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This condition appeared to be prevalent on a			
runway where open joints appeared to be the considered severe enough at this time to imp	major cause o	f cracking	g. The defects are not
At the time of this survey, the asphaltic co			
port parking areas or taxiway 8 extension.			
KEYWORDS: Flexible pavement performance and	evaluation	Airfields); Rigid pavement
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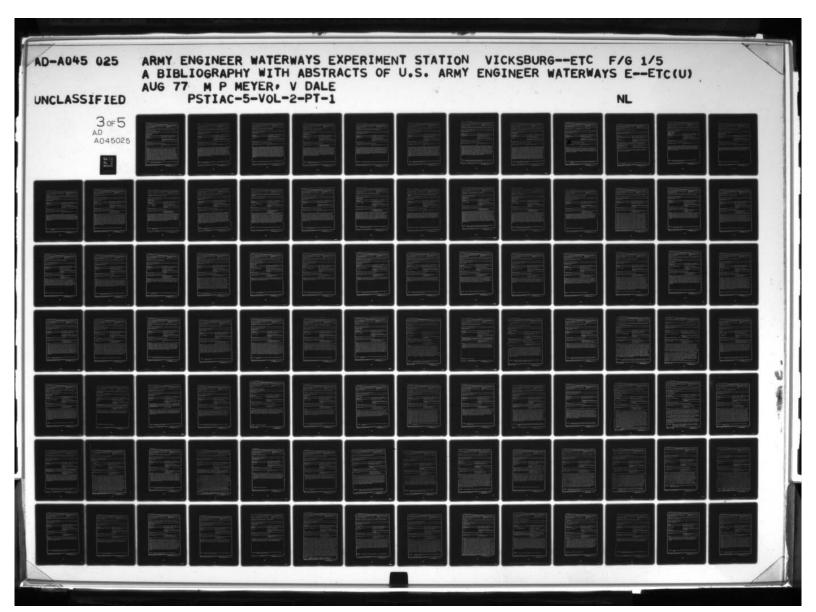
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Missile Range were subjected to traffic applic	ed in the air	t load car	t having a maximum
gross weight of 280,000 lb carried on a twin-	twin gear as	sembly havi	ng a tire inflation
pressure of approximately 300 psi. The prima	ry objectives	were to d	etermine (a) the losi-
carrying capacity of the area in regard to cu	rrent Air ko	ce aircraf	t. (b) the effect of
repetitive traffic, and (c) an evaluation of	the area for	the operat	ion of skid-mounted
vehicles. Repetitive traffic provided additi	onel strengt)	to the so	il by compacting the
loose surface sand and increasing the density	in the under	cluing mate	rial. Comparative
tests conducted at the Waterways Experiment S	totion with	theeled and	skid-mounted vehicles
tests conducted at the waterways Experiment 5	cation with	ide will pr	oduce more soil dis-
having equal loads and contact pressures indi	cate that sk.	lus will pr	not completely de-
placement than wheels. The magnitude of this	increased so	everity was	ally meduce the depth
fined by the tests. Compaction of the surfac	e layer will	substantie	illy reduce the depth
of rutting produced by wheels or skids.			
KEYWORDS: Aircraft loads; Airport runways; T			ed runway periormance
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Office of the Chief of Engineers for develor required depth of cover over pipe installed ders, and blast-protective surfaces. The failure of the buried pipe and differential both dynamic and static loads, and particulares and current and future multiple-wheel assembly loads. Between 1953 and 1957, the and consisted of a review of previous work Chief of Engineers, and related work descriveiew, no adequately validated, rational, determining design criteria for pipe coverlarge-scale prototype field tests, supplementations, would be necessary to ascertain developed.	oping adequad beneath addepth of cool settlement larly under landing goe investigat done in thibed in the and accepta. It became ented by model in the context was a context when the context was a context was a context with the context was a context with the context was a context when the context was a context with the context was a context	ate design of rfield paver for must be a fof the over loads induced are assemblication was rest is field for technical liable empiricate apparent the	riteria for minimum ments, adjacent shoul- adequate to prevent rlying pavement under ed by high-pressure es with their increasing tricted to office study the Office of the iterature. In this all method was found for that carefully performent and theoretical cal-
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DEVELOPMENT OF CBR DESIGN CURVE FOR M9M2 I	ANDING MAT	
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Vicksburg, Mississippi			
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INVESTIGATION OF POSSIBLE DAMAGES TO OLE M	ISS AIRPORT	AT OXFORD, 1	MISS., 26 OCTOBER 1962
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13. Adstract The request for the inspection cam	e through Co	rps of Engi	neers' channels follow-
ing submission of a claim for damages growi	ng out of th	e use of th	e airfield by military
transport aircraft. At the time of the dis	turbance, re	sulting fro	m the admission of Neg
James meredith to the University of Mississ			
air transports that made use of the Ole Miss	Airport (30	September	and early October 1962
The airfield consists of a single strip, 10	00 by 4700 ft	. running a	lmost directly in an
east-west direction. A taxiway intersects	the runway a	bout 1000 f	t from the west end
and connects the runway to an apron, 260 ft	wide and 55	O ft long,	that runs to the south
The airfield was designed to sustain up to	15,000-lb si	ngle-wheel	loads, and for several
years it has been subject to regular traffi	c of Souther	n Airways'	DC-3 aircraft having
12,000-lb single-wheel loads. Inspection of	the pavemen	ts indicate	d the presence of
cracks through-out the length of the runway	and in a po	rtion of th	e taxiway adjacent to
the runway. Cracking was not found in the	apron and ad	jacent port	ion of the taxiway.
It must be concluded that the military tran	sport aircra	ft using th	e Ole Miss Airport
caused significant structural damage to the	pavements.	Corrective	measures might range
from limited repair of severely damaged are	as plus a su	rface seal	coat over the entire
runway and taxiway to removal of pavement,	reworking of	base mater	ial, and repaying.
KEYWORDS: Airports; Flexible pavement per	formance and	evaluation	(Airfields); Pavement
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This report presents (a) and evaluation of an unsurfaced airstrip at Binh Hung, South Vietnam, and (b) several proposed designs which would permit operation of Caribou aircraft on the airstrip.

KEYWORDS: Tropical regions; Unsurfaced runway performance and evaluation; [South Vietman]

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13. ABSTRACT

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pat fabricated by Harvey Aluminum, Inc., Torra	ince, Calif.	The design	n curves were to re-
present 1600 operational cycles of an aircraft	having a b	0,000-1b gr	oss weight with a
single-wheel main gear assembly load of 27,000	lo and a 3	0-7.7 tire	inflated to 400 rsi.
DBR design curves were also desired for 1600 pin a single track to represent the calculated	asses of a	39,000-1b s	ingle-wheel load applie
launching of the 60,000-lb aircraft by catapul	t A test	osed on the	landing mat during
with different subgrade materials at different	strengths	and surface	d with the Harvey was
was constructed and subjected to accelerated t	raffic of s	ingle-wheel	loads ranging from
27,000 to 39,000 lb with a 30-7.7 tire inflate	d to 400 ps	i.	
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PERFORMANCE OF C-130 RAMP KIT	ON VARIOUS SOIL CONDIT	IONS	
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AIRFIFLD PAVEMENT EVALUATION; TURNER AIR FO	DRCE BASE, A	LBANY, GEORG	GIA, SEPTEMBER 1963
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Philip J. Vedros			
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A visual inspection of Turner AFB in Septer range from poor to good. The old 6-inthe aprons A, B, and D were in poor to failed by C-130, B-50, and other light-type aircraft.	ick portland condition. aft. Taxiwa	-cement con These pavem y C was rut	crete pavements on ents were being usei ted severely, and a
number of failures had occurred as a result F had a failed area where the crossover tan settlement were being experienced along the (apron E is the maintenance apron for B-52	kiway enters e south edge	the apron, of apron Ewh	and cracking and ere B-52's taxi
the KC-135 tankers and was not showing any had several cracked slabs around the drop it	appreciable inlet. Taxi	deteriorat	ion. The washrack No. 2 was generally
in good condition; a few cracks and occasion areas were apparent. Of interest on this the surface finish is being worn away and the surface finish words.	taxiway were	a number o	f small areas where The concrete in
these areas appears to be rather susceptible these areas are in the vicinity of a joint condition. The worst conditions were found	The NE-SW	runway was	generally in good
The new pavements constructed in 1963 were the new apron taxiway to the old 6-in. apro	on pavements	has settle	d in local areas;
however, this is the result of tying a heav pavement. The pavements at Turner AFB at t in satisfactory condition, except for the c	the time of told 6-in. por	this inspect	tion were generally nt pavement on aprons
A, B, and D and the asphaltic concrete pave KEYWORDS: Flexible pavement performance and formance and evaluation (Airtie	ment on tax nd evaluatio	r A Force	s); Rigid pavement per-
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with a test program to evaluate the abili	ty of F5A air	craft to ope	erate from an austere
airfield. The test site is compared in d	letail with a	hasty airfi	eld as defined in De-
rartment of the Army Technical Manual 5-2 cluded that: (a) Although the austere te	et runuar did	ret meet s	eliports. It was con
for a hasty airfield, it well represented	la typical ha	sty airfield	i. (b) The test mine
is capable of satisfactorily withstanding	for six mont	hs the numb	er of operations of
F5A aircraft required to support a corps	headquarters.	(c) The ar	pplication of water t
the test runway had negligible effect on	the surface C	BR, but wate	er added to a sod fie
with little or no vegetation due to dry w	eather is ben	eficial from	n the standpoint of
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KEYWORDS: Flexible pavement construction; Rubberized-tar pavements; [Selfridge Air Force Base, Detroit, Michigan]

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The Goodyear Aerospace Corporation, Arizona initiative prepared and submitted to the WE membrane system. The proposal was based on had been conducted previously in the labora ed that large-scale feasibility and develop membrane's ability as a water barrier and d suggested that a field-test program be cond membrane be installed under field condition al capability of the surfacing could be det ommended that placement of the membrane be by Goodyear that could be towed easily by a above-described proposal, the WES recommend 50 ft wide and 500 ft long, be constructed feasibility of placing the surfacing with suitability of the surfacing for operations	S a proposal initial mate tory and fiel ment work be ust cover for ucted at Ft. s as a runway ermined for a made with an crew of four ed that a fit at Ft. Bennir ield troops a	for an air erial deve- de by Good- conducted r soil sub- Benning, of extension aircraft of experiment men. Aft mer glass in ag, Ga., tund to dete	rfield surfacing lopment work that year, and it recommend to demonstrate the grades. The proposal. Sa., and that the most state the operations. It was restal handcart furnished the reviewing the membrane surfacing, or demonstrate the ermine the operational

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EVALUATION OF HARVEY MODIFIED AM2	LANDING MAT		
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William B. Fenwick			
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This study was conducted to compa by Washington Aluminum Co., Enter Harvey Aluminum, Inc., Torrance, reported by the U. S. Army Engine (MP) No. 4-615. It was also desi Washington Aluminum Co. by Alumin The Primary method of analysis waveloped from the test data to rep 60,000-1b gross weight with a sin tire inflated to 400 psi. CBR depavement design criteria and comp based on the mat performance. Dethickness required by the flexiblis equivalent. Two test sections grade materials at different strenum Co. extruded mats were constrand single-track traffic by the 1	prise, Ala., with the Calif., which had been Waterways Experiment of the compare the quant Company of Americans by comparison of Claresont 1600 operation agle-wheel, main-gear esign curves were devouting an equivalent the pavement design curves for the experiment of three ingths, each surfaced fucted and subjected the calif.	at designed en tested ea int Etation i uality of ex a (Alcoa) a BR design cu nal cycles o load of 27, eloped for t thickness of mats were ob rives by the e items each with one of	and fabricated by rlier and the results n Miscellaneous Paper trusions furnished nd Dow Chemical Co. rves which were defan aircraft having a 000 lb and a 30-7.7 he mats using flexible subgrade for the mats tained by reducing the amount to which the mat with different subthe Washington Alumi-
KEYWORDS: Aluminum landing mats	· Traffic tests: [AM2	landing mat	.1

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U. S. Army Engineer Waterways Exp.			CURITY CLASSIFICATION
Vicksburg, Mississippi			
GUIDE MANUAL FOR SELECTION AND USE THEATER OF OPERATIONS	E OF DUST PALLIATIVES	AND SOIL W	ATERPROOFERS IN THE
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S. AUTHORIS! (First name, middle initiel, leat name) George R. Kozan 'R. A. Pimental			
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This manual provides interim guida using materials for alleviating du ions on expedient airfields and ro and water pertinent to military op and the objectives and limitations	st and for water-proo ads in the theater of perations on unsurface	fing soils operations deirfield	in support of operat. The problems of dust and roads are defined.

This manual provides interim guidance to military engineering personnel in selecting and using materials for alleviating dust and for water-proofing soils in support of operations on expedient airfields and roads in the theater of cerations. The problems of dust and water pertinent to military operations on unsurfaced airfields and roads are defined and the objectives and limitations of soil surface treatments to alleviate these problem are stated. General procedures for applying a dust palliative or soil waterproofer are outlined, and the implications of these procedures to the ultimate selection of a material are presented. Various types of materials for treating soil surfaces to control dust and/or waterproof soil are described. Criteria to aid in the selection and use of a material, and various factors which may influence the final choice of a material are presented.

KEYWORDS: Dust control; Field manuals; Military operations; Waterproofing

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U. S. Army Engineer Waterways Experiment Station Vicksburg, Mississippi		Unclassified	
EVALUATION OF U. S. STEEL TYPE 4.5 AIR-DEK	LANDING MAT		
4. DESCRIPTIVE NOTES (Type of teport and inclusive dates)			
S. AUTHORISI (First name, middle Intitel, lest name) Hugh L. Green Gordon L. Carr			
6. REPORT DATE	70. TOTAL NO.	OF PAGES	16. NO. OF REFS
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11. SUPPLEMENTARY NOTES	12. SPONSORING	MILITARY ACTI	VITY
		ny Materiel ia, Virginia	
This report describes an investigation consignated U. S. Steel Type 4.5 Air-Dek. The U. S. Steel Corp., Pittsburgh, Pa., is a setype configuration core bonded by adhesives sides of the panels are joined by integral stainless steel pins. This investigation obtain information for use in comparing the requirements. The traffic tests were conducted load simulating actual aircraft opersingle-wheel load of 25,000 lb with tire in subgrade with a rated CBR of 4.4. Results Dek mat sustained 330 coverages of traffic mat in test item 1 met the project requirer Results from test item 2 indicated the proproduced by several variations in fabrication required to obtain valid conclusions. KEYWORDS: Steel landing mats; Traffic test	e mat which andwich stru son top and tongue-and-consisted of performanc ucted on a pations. The flation presof this invunder the aments (200 cobability of ion; however	was designed cture composite to the composite consideration of the Air repared subsection of the composite constitution of the composite	d and fabricated by the sed of an egg-crate steel facings. The ections and secured by g traffic tests to r-Dek with project grade with a rolling re conducted with a psi on a mat-surfaced revealed that the Airconditions, and the a 4-CBR subgrade). y Air-Dek mat being nsive testing would
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This report describes the accelerated traffic tests conducted with a test load and tire pressure selected to cause failure in an unsurfaced test section a a low-coverage level (less than 100 coverages) to determine the adequacy of present criteria for predicting low-coverage levels and to determine if there is added benefit in terms of increased traffic coverages from heavily sodded areas as opposed to areas which are clear of vegetation and root structure. Selection of the load and tire pressure was made from current criteria for the CBR required for operation of aircraft on unsurfaced soils and was based on the average CBR of the 0- to 6-in. depth. Results of the tests indicate that for conditions of these tests present criteria are somewhat conservative for predicting low-coverage levels of traffic. Although there was some benefit gained from the sod in one test item, there were not sufficient data to conclude that sodded areas will sustain substantially higher intensities of traffic. It is recommended that additional tests using other wheel loads and tire pressures be conducted to develop criteria for predicting low-coverage levels of traffic on unsurfaced areas.

KEYWORDS: Accelerated traffic tests; Soil strength; Trafficability; Unsurfaced airfields; Vegetative cover

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INVESTIGATION OF EXPEDIENT GROUND SUP SPRAY-DEPOSITION TECHNIQUE	REACING WITH A GL	ASS FIBER-RE	SIN MIXIURE BY A
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
3. AUTHOR(3) (First name, riddle initiet, last name) Robert Turner			
4. REPORT DATE	76. TOTAL NO		76. NO. OF HEFS
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II. SUPPLEMENTARY NOTES	U. S. A	army Materiel Iria, Virgini	Command
Three separate areas of soil subgrade produced by spraying a mixture containers in by weight on the ground and continues which cured to a rigid state it balsa panels were placed on a layer of luminate was placed on the surface structure consisting of balsa core and grooves of different configurations we mixture in order to provide stiffening third area, a flat sheet of reinforce subgrade. Each area was subjected to tire pressure of 200 psi. The area we frequent maintenance but sustained 35 flat sheet (CBR's of 15 and 25, respectant, with the rib section failing and the state of the section failing and the section fail and	e were surfaced within one-third compressing the matter of the laminate be of the balsa, the definition of the balsa, the reference formed in the gribs in the result of the sandwich of traffic of a 50 with the sandwich of traffic coveractively) were suited the flat-sheet	ith a reinform hopped glass erial with reference it cure hus forming a stic facings e soil subgrate was formed,000-lb single-type surfacinges. The are bjected to 26 section being	reed-plastic laminate fibers and two-thirds ollers into dense lam- 3-inthick, edge-grai ed, and another layer, a sandwich-type . In the second area, ade before apraying the stic laminate. In the d on the surface of the le-wheel load with a ing (CBR of 15) require eas with ribs and the d traffic coverages ing undamaged.
KEYWORDS: Expedient surfacings; Fib	er reinforced pla	istics; Traff	ic tests
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4. DESCRIPTIVE NOTES (Type of report and inclusive date	••) .		
George M. Hammitt, II			*
S. REPORT DATE	70. TOTAL NO	OF PAGES	76. NO. OF REFS
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Approximately 100 commercial labora properties of three samples of soil Independent Laboratories, Inc. The U. S. Army Engineer Waterways Experexpected in test results from comme termined by three "umpire" laborate are included for comparison. The radicable magnitude in many instance variation in values determined by t	under the sponsor ese results were st riment Station to d critical laboratories ories using careful results show deviations, indicating a w	ship of the atistically etermine who selected at ly prescribe tons from the ider than co	American Council of analyzed at the at variations might be t random. Values de- ed test procedures a mean to be of con-
KEYWORDS: Comparison; Soil Mechan: analysis; [American Cou	ics Laboratories; S acil of Independent	Soil tests (; Laboratori	Laboratory); Statistic: es]
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EVALUATION OF VARIOUS SIZES OF HA	NVEY ALUMINUM AM2 LAI	IDING MAT	
4. DESCRIPTIVE NOTES (Type of report and inclusive	dates)		
S. AUTHORIS: (First name, middle initial, fast name) William B. Fenwick			
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II. SUPPLEMENTARY NOTES	U. S. Na	eval Air En Lphia, Penn	ngineering Center
This investigation was conducted fabricated by Harvey Aluminum Comto sustain 1600 operational cycle with a single-wheel main-gear-ass 400 psi. A test section consisting and surfaced with three different coverages (equivalent to 1600 cycle a 27,000-lb single-wheel load with tested for its ability to sustain in a single track to represent the landing mat during launching of a	mpany, Torrance, Calies of an aircraft have sembly load of 27,000 ing of three items with size mat panels was cles of aircraft oper the a 30-7.7 tire influence in 1600 passes of a 39 me calculated loading	f. The basing a gross lb and a l th differen construct ations) of ated to 400 ,000-lb sin that would	sic AM2 mat was designed s weight of 60,000 lb 30-7.7 tire inflated to not subgrade strengths ed and subjected to 188 accelerated traffic of 0 psi. The mat was also ngle-wheel load applied d be imposed on the
KEYWORDS: Accelerated traffic t aluminum landing mat]		ag mats; [A	M2 landing mat; Harvey

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EVALUATION OF VARIOUS SIZES OF BUTLER	AM1 LANDING MAT		
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Cecil D. Burns William B. Fenwick			
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II. SUPPLEMENTARY NOTES	U. S. Na	val Air Eng phia, Penns	ineering Center
This study was conducted to determine AMI landing mat fabricated by Butler M was to sustain 1600 operational cycles with a single-wheel main-gear-assembly 400 psi. A test section consisting of surfaced with the various sizes of pan traffic of the 27,000-lb test load wit the 3- by 7-ft and particularly the 2-the service life of the panels solely 2-by 10-ft panels was about equal to size 2- by 12-ft panels, with no fabriance of the 2- by 10-ft panels was sup 7-ft panels. The degree to which the able to poor fabrication is unknown. results in improved performance of the	anufacturing Com of an aircraft load of 27,000 three items wit els was construct h tire inflated 1/2- by 8-ft pan on the basis of the performance cation defects n erior to that of poorer performan The use of end-c	many, Kansa having a gr 1b and a 30 h different ted and sub to 400 psi. els made it panel size. in previous oted in eit the 2-1/2-ce of the wonnector ba	is City, Mo. The mat coss weight of 60,000 lb 1-7.7 tire inflated to subgrade strengths and djected to accelerated Faulty fabrication of difficult to compare The performance of the tests of standard her size. The performby 8-ft or the 3-by dider panels is attributurs with the AMI mat
KEYWORDS: Accelerated traffic tests; landing mat]	Aluminum landing	g mats; [AM]	l landing mat; Butler
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EVALUATION OF AM2 LANDING MAT RE	PLACEMENT PANELS AND I	KEYLOCK AS	SEMBLIES
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William B. Fenwick			
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			ngineering Center
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ABSTRACT	<u></u>		
This study was conducted to evaluate			
cessories for use with AM2 landing			
also desired to evaluate the capa in a longitudinal direction. A t			
in both longitudinal and transver			
structed and subjected to acceler			
30.00-7.7 tire inflated to 400 ps			
of the replacement panels is sati	isfactory. (b) The ke	ylock asse	emblies function satisfac
orily. (c) The AM2 mat functions	s equally well when la	id either	longitudinally or trans-
versely.			
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KEYWORDS: Accelerated traffic t		a mate. fa	Mo landing matl

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EVALUATION OF BUTLER AM2 LANDING MAT			
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3. AUTHOR(5) (First name, middle initial, last name)			
William B. Fenwick			
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13. ABSTRACT	l		
This study was conducted to compare the per			
by Butler Manufacturing Co., Kansas City, M	io., with tha	t designed	and fabricated by
Harvey Aluminum, Inc., Torrance, Calif. Th			
sults were reported earlier by the U. S. Ar The primary method of comparison was by usi			
to represent 1600 operational cycles of an			
a single-wheel, main-gear assembly load of	27,000 lb an	nd a 30-7.7	tire inflated to 400
psi. CBR design curves were also developed	for 1600 pa	asses of a	39,000-1b single-wheel
load applied in a single track to represent	the calcula	ted loading	g imposed on the land-
ing mat during launching of the 60,000-lb a sisting of three items with different subgr	ircraft by c	eatapult.	test section con-
surfaced with the Butler mat was constructe	d and subject	ted to sco	elerated traffic of
single-wheel loads ranging from 27,000 to 3	3,000 lb wit	h a 30-7.7	tire inflated to 400
psi.			
KEYWORDS: Accelerated traffic tests; Alum	inum landing	g mats; [AM	landing mat; Butler
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SUBGRADE STABILIZATION WITH PORTLAND (CEMENT AND HYDRATED	LIME UNDER MODIFIED
TIL LANDING MAT		
4 DESCRIPTIVE NOTES (Type of report and inclusive dates)		
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5 AUTHOR(S) (Last name, first name, initial)		
Brabston, William N.		
Pimental, Richard A.		
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THE SOURCE MEANING HOLES		
	U. S. Army Mat	eriel Command
	Washington, D.	C.
13 ABSTRACT		
Sections of a low-strength subgrade we	ere treated with po	rtland cement and
hydrated lime to test the ability of t		
grade during inclement weather in com		
modified Tll aluminum landing mat. Da		
tion and during subsequent aircraft to		
ditional field measurements and labora		
several months after completion of the		
It was determined that both portland of		
3 percent admixtures, were effective		
subgrade to loss in bearing capacity of	luring wet-weather	operations. A section
also was constructed using polyethyler	ne sheeting over un	treated subgrade as a
protective membrane under the landing	mat, but the sheet	ing was of doubtful value
because of its inability to withstand	mat embedment with	out damage.
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KEYWORDS: Aluminum landing mats		abilization; Lime
soil stabilization; [Ill landing mat]	
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Vicksburg, Mississippi		26 GROUP	
2 FEPORT TITLE			
CONDITION SURVEY, VANCE AIR FORCE BASI	E, ENID, OKLAHO	MA	
4 DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report			
5 AUTHOR(S) (Last name first name, initial)		-,	
Vedros, Philip J.			
6 REPORT DATE May 1966	74 TOTAL NO. OF P	AGES	76. NO. OF REFS 5 (in text)
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13 ABSTRACT			
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This report presents the results Vance Air Force Base, Enid, Oklahoma, aircraft traffic. The field work at VExperiment Station survey team on 27 as construction history, climate, physhave been extracted from previous evaluded herein. It is concluded that to on the surface are due to a high asphablso, the use of the present high-presasphablic-concrete surface course in a where the voids content is below the millushing is occurring.	which was show Vance AFB was a and 28 March 19 sical propertie luation reports the pavement rualt content in ssure tire is i areas of high a	ring sign accompliance 65. Backs of parts of this atting arting artine surreasirance asphalt of the surreasirance	ns of distress from shed by a Waterways ekground data, such vements, and materials, s field and are in- nd movement occurring face course mix. ng the density of the content to a point
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. AUTHOR(3) (First name, middle initial, last name)			
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DEVELOPMENT OF CBR DESIGN CURVES FOR RUTTO STEEL LANDING MAT	INWAYS TO BE SURFACED WITH M8AL (FORMERLY
4 DESCRIPTIVE NOTES (Type of report and Inclusive dates) Final report	
5. AUTHOR(S) (Last name, first name, initial)	
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ducted on test sections constructed on with MSA1 (formerly T10) steel landing data on the service life of the MSA1 metire pressure, and subgrade strength. ways surfaced with MSA1 mat, similar to have been developed. Operations of mil ranging from 25,000 to 50,000 lb and ti aircraft with twin-wheel assembly loads test load cart. CBR, water content, ar before and during the traffic tests, ar recorded. Traffic was applied until the evident that 700 coverages could be concurves, which were developed by correlations which were developed by correlations are considered at to be surfaced with MSA1 steel landing	ire pressures ranging from 60 to 300 psi and s of 50,000 lb were simulated by means of a nd density of the subgrade were measured nd the condition of the test sections was ne test sections failed or until it was mpleted by the test load cart. The design ating the M&Al test data with flexible paveadequate for use in designing landing strips mat.
	sts; California Bearing Ratio; Runways; bgrades; [M8A1 (T10) landing mat]

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3 REPORT TITLE DUST ALLEVIATORS: Report 1, RESIN- AND	LATEX-BASE CONC	CRETE C	URING COMPOUNDS
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5 AUTHOR(S) (Last name. first name. initial) Decell, Joseph L.			
6 REPORT DATE June 1966	74. TOTAL NO. OF PA	GES	7b. NO. OF REFS None
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Station to evaluate two compounds for use as dust alleviators. The compounds, a resin-base concrete curing compound and a latex-base concrete curing compound, were applied to two different types of materials. One material was Vicksburg loess and the other was Reid Bedford sand. The curing compounds were applied to the two materials, allowed to cure, and tested using a six-blade fan which produced velocities across the material surface averaging approximately 4000 ft per min. As a result of these tests, the following conclusions were made: (a) neither compound could be used in traffic areas; (b) the compounds could be used in such nontraffic areas as the fringe areas of a helicopter landing pad, runway, or rocket launch pad: (e) the resin-base compound performed satisfactorily on sand, but was not satisfactory when applied to the loess; (d) the latex-base compound performed satisfactorily on the loess, but was not satisfactory when tested on sand; (c) when wetted to simulate exposure to rain, the resin-base compound applied to the sand failed under testing. It is recommended that further tests be conducted to evaluate other compounds for use as dust alleviators. These tests should be performed using larger test areas and higher disc loads, with variations in application techniques. These compounds should also be tested under the downwash of a jet engine in order to evaluate their performance under conditions of jet VTOL and STOL aircraft traffic.

KEYWORDS: Curing agents; Dust control; Materials; Resin concrete

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FIELD TESTS OF AM3 LANDING MAT			
4. DESCRIPTIVE NOTES (Type of report and inclusive da	(60)		
5. AUTHOR(5) (First name, iniddle initial, last name)			
Hugh L. Green			
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Field tests were conducted on AM3 landing mat to determine the capability of the mat to support helicopter operations when floated on water and when placed on marshy soil having a CBR of about 0.25 percent. The mat was an aluminum, cellular-type structure filled with polyurethane foam, with top and bottom facings fabricated from aluminum alloy sheets. The side and end connectors were of an extruded aluminum alloy. The individual panels were assembled on a pond into an approximately 62- by 90-ft floating landing pad. The pad was subjected to repeated landings and taxiing operations of a UH-34D helicopter with loads ranging to 13,000 lb and landing forces ranging to 2.41 g. The pad was then disassembled, moved to a marsh area, and reassembled. The pad was again subjected to operations of a helicopter with a gross weight of 12,000 lb and landing forces of 2.18 g.

KEYWORDS: Aluminum landing mats; Floating landing mats; Helicopter landing pads; Polyurethane resins; Traffic tests; [AM3 landing mat]

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OBJECTIVES AND REQUIREMENTS (1956-19			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates	•)		
S. AUTHORIS (First name, middle initial, last name)			
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This report consists of a collection period 1956 through 1959 which summe pertinent to the military soil stable cludes memoranda, correspondence, as the delineation of the broad project ameters to provide realistic guides of the stabilization research programmers.	arize the developm ilization research nd minutes of conf t objectives in sp for the developme	ent of obje- activities erences whi- ecific term ent, evaluat	ctives and requirements . The collection in- ch were concerned with s and measurable par- ion, and design phases

of the stabilization objectives into four basic classifications or categorie various military road and airfield operational requirements and functions, to be accomplished by soil treatment. Significantly, the basic classifications are sufficiently flexible and encompassing to permit the inclusion of new requirements or revisions in existing requirements to conform with changes in military operational concepts. thus maintaining a logical continuity in the long-range approach to the soil stabilization problems.

KEYWORDS: Military operations; Soil stabilization; State of the art studies

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fabricated from two l-ft-wide extrusions we A test section consisting of three clay sub	lded togethe	r to form	a 2-ft-wide plank.
CBR) and one loosely compacted sand item wa	s constructe	d and surf	aced with the two-
piece mat. The test section was subjected ing operations of an aircraft having a 60,0	to uniform a	nd single-	line traffic represent-
gear assembly load of 27,000 lb and a 30-7.	7 tire infla	ted to 400	psi.
KEYWORDS: Aluminum landing mats; Traffic	tests; [AM2]	landing mat	; Harvey Aluminum
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13. AdSTRACT		-	
Accelerated traffic tests were conducted at 1966 on panels of MO-MAT manufactured by Ai MO-MAT is a new and highly advanced fibergl glas. The MO-MAT consists of 11- by 50-ft a unique waffle-like configuration. The material thickness and has a uniform material 1 lb per sq ft. This preliminary investige 64 in. square connected by rivets placed in	r Logistics of reinforce centinuous paterial is apthickness of ation was con-	Corporation in plastic to plastic	n, Pasadena, California material made of Strato- tratoglas molded into y 5/8 in. thick in and weighs about
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KEYWORDS: Accelerated traffic tests; Fibe [Mo-Mat landing mat]	r reinforced	plastics;	Plastic landing mats;

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KAISER LANDING MAT FAILURE STUDY (MX-19)			
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Lymen W. Heller			
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Kaiser landing mats (MX-19) are fabricate to each side of an aluminum honeycomb cor aluminum connectors are welded to the ski resulting circumferential internal void i When simulated aircraft wheel traffic was the Waterways Experiment Station (WES), t direction of wheel travel eventually spli severed from the connector. The fracture mat deflection occurred; the mat was then After review of the fabrication of the ma and polymer, and the laboratory tests, the tions of Kaiser mat are summarized.	e to form a c n along the p s filled with applied to j he connector- t open and the soon present considered to	omposite sa eriphery of a polymer oined secti sein welds e sandwich ed a tire h have reach al properti	andwich. Extruded of the sandwich and the potting compound. It is matting at parallel to the was progressively nazard or excessive and a failure condition.
KEYWORDS: Aluminum landing mats; Compositanding mat failures; [Kaiser	ite materials aluminum land	(Landing m ling mat; M	at construction); X-19 landing mat]

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FORKLIFT OPERATIONS ON T17 MEMBRANE ST STORAGE AREAS; ENGINEER TESTS	URFACING ON SAI	D SUBGR	ADE IN OPEN-
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report			
5. AUTHOR(S) (Lest name, first name, initial)			
Tucker, Sidney G.	•		
Vollor, Timothy W.			
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13. ABSTRACT	J		
This investigation was conducted to d membrane as a surfacing material for storage areas at Cam Ranh Bay, South long was excavated to a depth of 24 i The membrane was placed over the sect forklift was used as the test vehicle sand subgrade and on a slightly compa for the dry sand subgrade ranged from 2 to 8. Tests performed during this Model RT-150 forklift loaded to full the T17 membrane surfacing placed ove one-half pay load, the forklift can o made to turn or steer the vehicle; wh slip excessively and cause severe abr drive wheel tires; subgrades that rut frame of the forklift to drag, thus t that the T17 membrane should not be u of forklifts over loose sand subgrade load-spreading capabilities should be KEYWORDS: Forklift trucks; Membr grades; Traffic tests; membranes	operations of Vietnam. A ten. and backfillion and secured. Tests were peted sand subgill to 3 and foinvestigation pay load (15,00 r a loose sand perate satisfation empty, the asion of the state as much as 7 caring the surged as a surfaces. Instead, 1 used.	forklift st area led with d. A Hy performe rade. Dr the we indicate 00 lb) c subgrade ctorily forklift arfacing in. will face. I cing matightweig corage	s in depot open- 20 ft wide and 50 ft poorly graded sand. ster Model RT-150 d on a loose, dry uring tests, the CBR t sand subgrade from d that a Hyster annot be operated on e; when loaded to if no attempts are 's drive wheels will and wear of the cause the lifting t was determined erial for operations that surfacing with
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TESTS OF LIGHTWEIGHT WATERPROOFING	MEMBRANES FOR I	USE BENE	EATH AML LANDING MAT	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report				
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13. ABSTRACT				

This study was conducted to determine the ability of 12 lightweight membranes to waterproof the subgrade beneath solid planks of AMl landing mat. A test section 24 ft wide and 110 ft long was constructed under the protection of a hangar to provide the conditions required for accurately controlled comparative traffic tests. One half of the test section consisted of a heavy clay (CH) subgrade, and the other half consisted of a fine, silty sand (SM) subgrade.

In the field, 200 coverages were applied to the test lane with a singlewheel load of 25,000 lb (at a 250-psi inflation pressure). In the laboratory, the weight, breaking and tearing strengths, elongation, and resistance of the membrane to flame, heat, fuel spillage, and weathering were determined.

The traffic tests indicated that membrane materials such as the Tl6, Herculite 3-ply, Griffolyn No. 105, Celtex 40 mil, and polycthylene 30 mil water-proofed both sand (SM) and clay (CH) subgrades beneath the AMI landing mat for 200 coverages. Further evaluation of the membranes indicated that the Tl6 membrane and Herculite 3-ply are the most desirable materials for use beneath the AMI landing mat.

KEYWORDS: Aluminum landing mats; Membranes (Airfields); Subgrades; Traffic tests; Waterproofing; [AMl landing mat; Herculite 3-ply membrane; T16 membrane]

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EVALUATION OF THREE-PIECE AM2 ALUMINUM LAN	DING MAT		
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13. ABSTRACT			
This investigation was conducted to evalua	te three-pi	ece AM2 land	ling mat extruded by
the Michael Flynn Manufacturing Company, P			
Washington Aluminum Company, Enterprise, A			
8-inwide extrusions welded together to f			
sisting of one sand item and three clay su values was constructed and surfaced with t			
subjected to uniform-coverage and single-1			
aircraft having a 60,000-1b gross weight w			
of 27,000 lb with a 30-7.7 tire inflated t	o 400 psi.	Based on th	ne results obtained
in this study, it is concluded that: (a)	When placed	on a subgra	ade having a CBR of
6.8 or greater throughout the period of tr	affic, the	three-piece	mat will sustain
1600 cycles (188 coverages) of an aircraft			
a 400-psi tire-inflation pressure. (b) Th			
(in a single path located 2 ft or more from wheel load with a tire-inflation pressure	of 400 rsi	when placed	on a subgrade having
a CBR of 5.7 or greater throughout the per			
the mat in these tests was not materially	affected by	the three-p	piece nature of the
mat planks.			
KEYWORDS: Aluminum landing mats;	Subgrades	; Traffic	tests; [AM2
landing mats]			
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1971. Other requests for this documents Experiment Station. **DPPLEMENTARY NOTES** The purpose of this report is to p Pease Air Force Base (AFB) in July plate 1. The survey was concerned flexible pavements relative to the (b) the maintenance methods being tests of pavement, foundation, or the investigation was limited to v and pertinent conclusions regarding	resent the results of mainly with (a) the results of mainly with (a) the results of the performance of the performance of the results of the performance of the results of	ed to U. S. Chief of Exitor, U. S. cton, D. C. of a condition the airfield experformance and life or condition their effective perform This report This report The flexible	Army Engineer Water- organieers, U. S. Army and an army performed at an an army performed at an an army engineers. No physical and during this survey; to includes a discussional pavements based on armance and evaluation

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EVALUATION OF KAISER ALUMINUM HONEYCOM	B LANDING MAT		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report			
5. AUTHORISI (First name, middle initial, last name)			
Robert Turner Cordon L. Cerr			
C. REPORT DATE	74. TOTAL NO		75. NO. OF REFS
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11. SUPPLEMENTARY NOTES	12. SPONSORI	NG MILITARY AC	TIVITY
		rmy Materie ton, D. C.	1 Command
13. ABSTRACT			
The investigation reported herein was landing mat. The mat, which was design Chemical Sales Company, Inc., Oakland, of an aluminum honeycomb core bonded by Tacings. The extruded edge connectors core. The panels are joined at two edges are joined by an overlap-und sertion of a connector bar. This investo obtain information for use in compact to obtain information for use in compact requirements. The traffic tests we rolling wheel load simulating actual at with a single-wheel load of 25,000 lb mat-surfaced subgrade with a rated CBR that the Kaiser mat sustained 378 covertions equivalent to 550 coverages on a quirements (200 coverages on a 4-CBR st by overstressing the potting compound to core. Further study and testing are not that repairs can be made when panels in KEYWORDS: Aluminum landing mat	ned and fabric Calif., is a y adhesives on are welded to ges with a hin erlap type constigation consting the perform conducted irreaft operat with a tire-in of 3.6. Resurages of traff 4-CBR subgrada by 17 between the ededed to devel a the interior	ated by the sandwich-ty top and bo the facing ging-type conection and isted of en rmance of ton a preparations. These flation prelts of this ic under the e, thus except percent. The second of a section of a section of a section is the sandwich and the second is section of a section is section.	Kaiser Aluminum and pe structure composed toom to aluminum s and bonded to the onnection. The other locked together by ingineering traffic tests he Kaiser mat with project subgrade with a e tests were conducted soure of 250 psi on a investigation revealed e above-stated condicating the project re-Failures were developed and the honeycomb cable panel in order on are damaged.
Kaiser aluminum hon	eycomb land	ing mats]	os, marine tests,

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This report presents th	f the airfield parendition survey we avements relative	vements is shore as follows to usage and	own in fig : (a) The predicted effectives	ed at Loring AFB in. 1. The major areas performance and condit- life or design re- mess of the maintenance sual observations made

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13. ALLTRACT The various parameters that will define downwash flow from present and Nuture, high-performance V/STOL aircraft will be substantially more severe than those that define the downwash of the helicopter, which represents VTOL aircraft currently in use. In addition, the intense heat from some lift systems will be an added problem. It is desirable that the parameters of downwash flow, including any heat generated, be known in order that provision for their effects can be incorporated in airfield design criteria. This study included a review of available literature and visits to installations that are concerned with operational-type V/STOL aircraft in an effort to assemble operational downwash data. Limited data are presented. A discussion of pertinent present and future experimental V/STOL aircraft, engines, and configurations is presented herein. This discussion can be used to interpret the feasibility of an operational aircraft. The limited data found to be available are presented and disember uning experience with helicopters as a basis for comparison. The attempt to juther operational downwash data revealed a lack of such data and that there are no plane for obtaining such information. In anticipation of need for criteria for V/STOL wirfield design, it is suggested that one of two programs be implemented: (a) Introduce a requirement for obtaining downwash characteristics information in the flight and control testing programs of current and future V/STOL aircraft, and (b) Determine the downwash characteristics experimentally by simulating each of the various V/STOL lift mechanisms. The first program appears to be the more desirable and economical.

KEYWORDS: Blast effects; Landing fields; Short take-off and landing aircraft; Vertical take-off and landing aircraft

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Donald N. Brown					
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13. ABSTRACT					
This paper presents limited background on					
some of the concepts on which current cri various problem areas in development of t					
of applicability of flotation criteria pr					
paper, emphasis is given to the particular aircraft characteristics that contribute					
good or high flotation and some discussion					
current criteria, which recent research in flotation.	ndicates may	nave a sig	nilicant ellect on		
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D. ABSTRACT		on, D. C.	
The purpose of this report is to prese Bicycle Army Airfield (AAF) in March 1 observations, and no tests were conducted ways. A layout of the airfield with plate 1. Pertinent data are included 1966 for another project.	1967. The inspected on the exist proposed future	ection was sting unsu airfield	limited to visual rfaced runways or taxi-construction is shown in
KEYWORDS: Unsurfaced runway performan Irwin, Calif.]	nce and evaluati	ion; [Bicy	cle Army Airfield, Ft.

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XC-14CA AIRCRAFT FLIGHT TESTS; LANDIN	NG STRIP EVALUATI	ons	
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13. ABSTRACT			A
Tests were conducted at four sites in	a California to d	etermine the	capability of the
XC-142A aircraft to operate on or how	ver over unprepar	ed or expedi	ently surfaced land-
ing strips. Soil data were collected	from eight site	s, but only	four of the sites
were used for subsequent flight test			
all performance of the XC-142A was go			
except one. However, results also in			
nose gear should be increased, and me			
rimming as occurred at one of the ter wing angle versus soil recirculation			
completed, a mineralogical analysis of			
Results of the analysis are presented		rom the rou	STOCS WAS IMAGE.
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KEYWORDS: Aircraft; Ground fl	otation: Land:	ing strips	Unsurfaced
runway performance			
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An airfield runway constructed	with MRA1 met assessed	damaga to to	ree of sireraft	
because of sharp edges along t				
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tions proposed to prevent this	This report describ	ar strips (i	ests conjucted on	
Mil mas, laid on a prepared s				
rolled edges of the panels. S				
loading were used to determine				
and if they would withstand ro				
indicated that although the fi				
tests, they did not appreciabl				
Therefore, other means of redu				
increiore, other means of read	ering or errannaving on	c offe acoust	ge are recommendent	
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EVALUATION OF REPUBLIC STEEL GROUND MAT	FOR USE IN DE	EPOT OPEN-S	STORACE AREAS	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)				
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S AUTHOR(S) (First name, middle initial, lest name)				
Hugh L. Green				
Gordon L. Carr				
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This report describes an investigation to evaluate Republic Steel ground mat for use in open-storage areas. The corrugated panels, which are 11-1/2 ft long, 3 ft 1-5/8 in wide, 1 in. thick, and weigh 105 lb each, are connected by overlapping the corrugations and bending tabs into slots. Two test series were run. In test series I, traffic was applied with two forklifts, the Hyster Model RT-150 and the Towmotor Model 20-RS, both carrying various pay loads on three different subgrades, two heavy clay and one sand. Ground mat on the sand section withstood traffic better than that on the clay sections. Static loads with pallets of 6000 to 15,000 lb were placed on the section for periods up to 60 hr, with a maximum settlement of 0.4 in. recorded. In test series II, double layers of mat were placed in two patterns over wet and dry sand. Individual layers were not interlocked. The test sections were trafficked with the RT-150 Hyster, a 2-1/2-ton M35 truck, and a 5-ton M54 truck. The Hyster was the most critical load applied. It was concluded that the single-layer ground mat was inadequate for use in open-storage traffic areas. Double layers nested together will perform satisfactorily with continued maintenance over a period of 2 to 3 months. It is recommended that the mat be oriented so vehicles travel perpendicular to the corrugations in heavily trafficked areas.

KEYWORDS: Ground matting; Open storage areas; Steels; Traffic tests

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COMPARATIVE PERFORMANCE TESTS OF AM2 MAT	FROM VARIOUS	EXTRUDERS	AND FABRICATORS
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5. AUTHORIS) (First name, middle initial, last name)			
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Walter R. Barker			
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3. ABSTRACT This investigation was conducted	to evaluate	and compare	the performance of
AMP mat fabricated by Washington Aluminum			
by Kaiser, Dow, and Alcoa with that of Al			
Aluminum Co., Torrance, Calif. A test s			
and two clay subgrade items with various faced with the mats. The test section we			
equipped with a single-wheel gear assembly			
operated to simulate various operations			
runway. Based on the results obtained in			
performance of AM2 mat is greatly influen			
The welds on the Dow and Alcoa mat extru			
Aluminum Co. were of poor quality and re-			
fications of the welding procedure by Wa			
factory mat from the same extrusions. b			
the Kaiser mat extrusions resulted in a			
number of load repetitions (passes) in a tested. c. All mat extrusions tested w	single track	minimum CA	eny of the other mats
AM2 mat, provided proper fabrication and			
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13. ABSTRACT				
Hydraulics Divibeaches in the 20 percent. Was areas. The tes materials such with and withous and subjecting ramps were test and then by a case observed is Standard militaruck and the M thereof satisfac appreciably bet	were corducted on a full-seasion. The beach was constructed. The beach was constructed induced upon the beach is were conducted by installars. Mo pierced steel plank is a motion and with and without these installations to wave ed by first observing detrimentation of wave action as in determining detrimental error vehicles used in the training steel the beach ter than the natural, bare as a ramps are short-term due to	ected of same ons (TO). Estimulated the Ling various anding mat a cout T16 members action and mental effects of traffic lifects of trafficking eyes. None of a foreshore sand. Benef	d approximate and slope ose found in types of and XML9 alternate over the caused oading. The affic and the materior provider its gained	ating that found on s ranged from 10 to in TO cove and bay expedient surfacing unfamum landing mat a prepared sand beach traffic. The separat by wave action alone hese same factors waves on a bare beach he M151 1/h-ton cargo als or combinations d an OTB ramp by installation of
su	uminum landing mats; B erfacings; Membranes; S eaffic tests			
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PROTESTED AND ENGRAPORY TESTS OF MAA	1-A STEEL LAND	ING MAT	
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MSA1-A). MSA1-A mat panels contain a ly eliminate expessive tire damage for airc skid-resistance and tire-wear tests, and comparisons were made of MSA1-A mat, TIO turers. The effect of the joggle on per determined due to the premature and unex opposite bayonet 15. The performance of occurred. There was no significant diff mats (i.e. mats with and without the jog damage occurred in any of the skid tests three mats tested and was not considered enountered in an interchangeability test would be desirable not to place MSA1 and sheet and end-connector bar material met these findings, it is believed that modify joggle is not warranted. KEYWORDS: Landing mats; Steel 1 [MSA1-A landing mat]	8-in. joggle at raft operating laboratory still laboratory lab	long the re- on this ma- rength test mat made be e MSA1-A ma- of the main as satisface frame of ely). No es reasonable significate types of man the same tion require rolled-be	olled-box edge to at. Traffic tests, ts were conducted. by various manufacat was not fully tat the locking lugs ctory since no failures the MSA1-A and MSA1 appreciable tire ly uniform for all ant difficulty was at; however, it runs. The MSA1-A rements. Pased on ox edge to incorporate
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was performed to determine the effective sand, to establish appropriate field us of envirement factors such as temperat for diffusion on the stabilizing capabilment was studied and assembled to provian asphalt distributor, hand-held hoses that were constructed and tested, unded a constrate the capabilities for stabilable three of the materials examined and the used effectively to stabilize sand factor correctly and under conditions app KEWORDS: Emulsions; Erosion cont Sands; Soil stabilizati	ment capabilitieness of the tage parameter are, humidit, ities of the de capabilities, and a backer extremely dizing sand. I all of the corporate to trol; Polypton	ties. A lat selected mars, and to cay, and qualimaterials. Les for sprayadverse clim It was geneticens of equided purpose, the achiever	coratory investigation aterials in stabilizing examine the influence ity of available water Distribution equipaying sand mounds with er. Field test section conditions, to erally concluded that tipment assembled can provided they are ment of maximum results
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The major/minor wheel vehicle, an experimental vehicle that employs the Terrastar locomotion concept, was tested on soils having a wide range of strengths, on asphalt pavement, and in water. The purpose of the tests was to determine (a) the minimum soil strength, in terms of rating cone index, that will permit the vehicle to complete one and 50 passes in a straight-line path (i.e. the vehicle cone index for one pass, VCI, and 50 passes, VCI₅₀), (b) one-pass drawbar pull-slip and motion resistance-soil strength relations, (c) hard surface drawbar pull-vehicle speed relations, (d) slope-climbing capabilities, (e) water speed, and (f) water exit capabilities. Mechanical breakdowns prevented completion of some portions of the test program. The experimental VCI50 was determined to be 21 and the experimental VCI1 to be 8. This compares favorably with the computed VCI₅₀ of 27 and computed VCI₁ of 14. The maximum drawbar pull on a paved surface was 65 percent of vehicle weight; the maximum drawbar pull on soil was about 57 percent of vehicle weight. Maximum drawbar pull and motion resistance were shown to be related to soil strength. The maximum water speed was 3.0 mph. Appendix A presents the formula and computations for determination of the vehicle cone index.

KEYWORDS: Field tests; Movility; Pavements; Terrastar locomotion concept; Trafficability; Water performance

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EVALUATION OF DOW CHEMICAL FXTRUDED LAND	ING MAT		
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This report describes an investigation composed for the piece hollow extrusions fabricated from 60 MX18-C) aluminum alloys, artificially aged locked along the sides by means of a hinge an integral part of the basic panel extrusions connectors welded to the basic panel extrusion westigation consisted of traffic tests to performance of the mats with project requion a prepared subgrade, with a rolling whee tions. These tests were conducted with a inflation pressure of 250 psi on a mat-sur 4.0 for the MX18-B and MX18-C, respectivel just met the project requirement of 200 coceeded the traffic criteria by 35 percent	The mats, whin Dow Chemical 161 (designat to the T6 cutype connection. End coordinate obtain informements. The load simu 25,000-lb sifaced subgray. The MX18 werages on a	ch were des Co., Middle ed MX18-B) ondition. tor, the connectors and noverlap abeen joined mation for e traffic that in actual ngle-wheel de with a rangle-wheel de with a rangle-wheel	signed and fabricated and, Mich., are one- and 7005 (designated The panels are inter- proposed of extrude and underlap section a together. This in- use in comparing the cests were conducted all aircraft opera- load with a tire rated CBR of 3.7 and sidered marginal as it
ported herein were evaluated against crite 1965 by the U. S. Army Materiel Command an were subsequently revised, and an updated on 2 April 1968. Further study and testin dite mat placement and field serviceabilit corporate the described improvements in the discussed herein, and also that the mats be the engineer design tests. KEYWORDS: Aluminum landing mats; I [XM18-B (Landing mat); 2]	eria for medial summarized qualitative ag are needed by. It is respected to the service to the s	um mat este in Appendi materiel re to develop commended t xercise the sted to val	irable. Test data re- ublished in January ix A. The criteria equirement was approve ancillaries to expe- that the fabricator in a fabrication controls lidate the findings of mats);

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EVALUATION OF LOAD-DISTRIBUTING CAPABILITY	OF T17 MEM	BRANE IN ROA	AD CONSTRUCTION
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report			
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This study was conducted to determine if Titive in increasing the load-carrying capabilitied construction. A test section approximate the structed as a two-layered system consisting a uniform-strength subgrade (CBR ≈ 4). This items, each 25 ft long. One item involved various manners on the other three items. applied on the test section with a test los wheel load assembly with the tire inflated Comparative performance of the various test tests indicated that no significant load-dimembrane.	ility of a simately 15 is g of a unifor test section membrane A total of ad cart equito produce titems was	coil when us twide and orm-strength on was diving the transfer at 100 coveraginged with a contact poserved.	sed in road and air- 100 ft long was con- h base (CBR ≈ 10) and ded into four test membrane was used in ges of traffic was 125,000-lb single- bressure of 100 psi. The results of the
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13. ADSTRACT			
This investigation was conducted to fabricated by May Aluminum, Inc., El two 12-inwide extrusions welded to consisting of one sand and two clay was constructed and surfaced with the coverage and single-line traffic rep 60,000-lb gross weight with a single a 30-7.7 tire inflated to 400 psi. is concluded that: a. The May two-of aircraft operations with a 27,000 pressure when placed on a subgrade h period of traffic. b. The May two-single-wheel load with a tire-inflat 1-1/2 ft or more from the mat end jo or greater throughout the period of tests was not materially affected by KEYWORDS: Aluminim landing ma Aluminum, Inc.]	Campo, Texas. Dether to form a subgrade items a subgrade items are mat. The tess are main-gear based on the repiece AM2 will believed awing a CBR of piece AM2 will sion pressure of wints when places are fire. C. Go the two-piece are the complete are fire.	The mat was a 2-ft-wide; with various t section wa tions of an a assembly 1 sults obtain 1600 1 load and 41 or great sustain 1600 400 psi in a lon a subgrancal behaveature of the	fabricated from plank. A test section CBR strength values s subjected to uniform aircraft having a oad of 27,000 lb with ed in this study, it cycles (188 coverages 00-psi tire-inflation er throughout the passes of a 27,000-lb a single path located ade having a CBR of 4. ior of the mat in these e planks.
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13. ADSTRACT

11. SUPPLEMENTARY NOTES

The purposes of the investigation reported herein were to (a) determine the techniques required to construct a waterproof fine-grained soil base course by encasing the soil layer in a protective membrane envelope, (b) evaluate several types of membranes for use in this waterproofing techniques, and (c) determine the effects of aircraft traffic under a range of weather conditions on a base course so constructed. A test section was constructed having (a) a highly compacted lean clay base course over a low strength subgrade of the same soil, and (b) a heavy clay base course over a loose sand subgrade. During construction, various surface and subsurface membranes were bonded together to form a single watertight envelope encasing both base courses. The initial strengths of the top 6 in. of the lean clay and the heavy clay were approximately 32 and 31 CBR, respectively. The test section was trafficked with a simulated F-4C aircraft loading. Traffic was applied intermittently for a 7-1/2-month period. From the results of this study, it was concluded that: a. A fine-grained soil base course can be successfully protected from water intrusion by encasement in a protective membrane envelope. This can be accomplished in the field using the techniques and equipment described herein. b. T1 and T2 membranes are not satisfactory for use as surfacing on a tactical assault field of this type. Tl6, Tl7, or WX18 membranes will withstand the abrasive action of a free-rolling F-40 aircraft wheel. However, a recently completed comparison study indicated that only the WX18 has sufficient tear strength to sustain braking and short-radius turns of F-4C aircraft. \underline{c} . All subsurface membranes used in the tests reported herein were effective in waterproofing, but the T16 was more durable than the lighter membranes and less subject to damage during construction.
KEYWORDS: Bare base support; Landing strips; Membrane enveloped soil layer; Membranes
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This investigation was conducted to evaluate the load-distributing capability of thin, very high-strength steel membrane. A test section was constructed of uniform-strength heavy clay and surfaced as follows: 15-mil steel membrane, 11-mil steel membrane, and neoprene-coated nylon membrane placed directly on the subgrade; 15-mil steel membrane over subgrade sprayed with an asphalt tack coat; and one unsurfaced area. The test section was trafficked with a test cart with a 20.00-20.00, 22-ply C-130 aircraft tire inflated to 85 psi loaded with 30,000 lb. Observations and tests were made to evaluate the performance of the various membranes and the subgrade. Laboratory tests of the tensilé strength of the steel membranes were made. Based on the results obtained by this study, it was concluded that: (a) when placed on a subgrade of 5- to 6-CBR strength and trafficked with the load cart described above, neither the 11-mil nor the 15-mil steel membrane exhibited any appreciable load-distributing capacity; (b) application of an asphalt tack coat on the subgrade did not materially improve the performance of the steel membrane; (c) although very high in tensile strength, the steel membranes used in this test did not withstand the differential stresses and flexing imposed by rolling-wheel traffic.

Washington, D. C.

KEYWORDS: Clays; Load tests; Membranes; Steels; Subgrades

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inspection of the facilities personnel.

KEYWORDS: Airfield drainage; Subsurface drainage; [Little Rock Air Force, Base, Arkansas]

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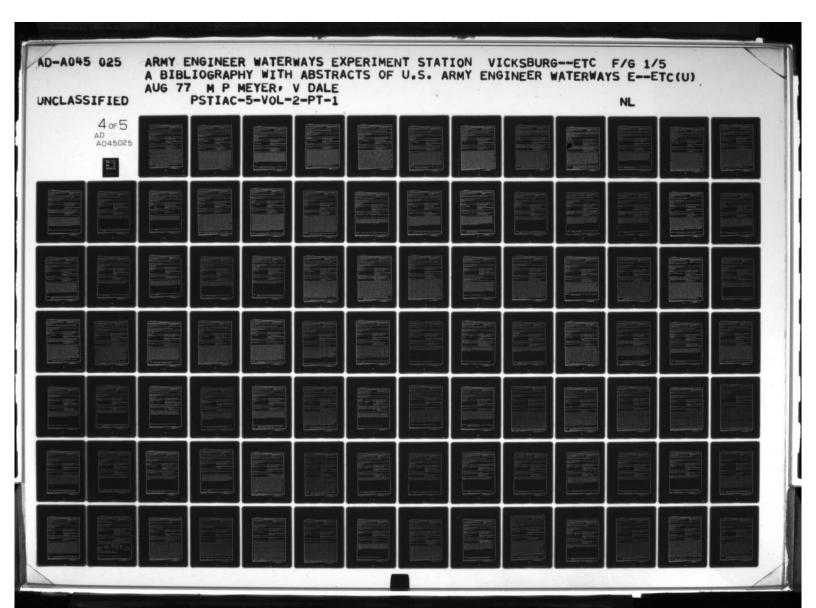
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13. ABSTRACT				
The analysis of linear viscoelastic layere	ed systems u	nder any an	cially symmetrical	١,
time-dependent surface traction is present	ted. Inerti	al effects	are disregarded,	and
solutions are obtained for the normal, rac	dial, and sh	ear stresse	es, vertical defle	ection
and radial displacements at any point with	in the half	space in n	nultilayerea syste	ems.
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Laplace transformation is applied to replace the time variable with a transformed variable, and thus change the viscoelastic problem into an associated elastic one. The solution of the associated elastic problem, when transformed into the real time variable, will give the desired viscoelastic solution. Sample numerical results are presented. The analysis is an essential step in the development of a rational method of design for flexible pavements, since such pavement systems respond in a markedly time-dependent fashion.

KEYWORDS: Displacement; Flexible pavements; Layered systems; Stress-strain relations; Viscoplasticity method

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MATERIALS INVESTIGATED FOR DUST-CONTROL PR	OGRAM (SOUTHE	(AISA TSA			
i. 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report 5. Author(5) (First name, middle initial, last name)					
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U. S. Army Materiel Command Washington, D. C. D. Abstract: This report describes an investigation to evaluate the use of some asphalt and latex emulsions, mulches, erosion-control blankets, lightweight membranes, and filter blankets as means of controlling dust in the Southeast Asia theater of operations. These materials were subjected to helicopter downwash blast, fire, rain, waterproof, and random vehicle traffic tests. The helicopter tests consisted of placing the materials on three different soils, dry sand, clayey silt, and heavy clay, contained in three test carts with each material placed on each soil. Materials that required a cure period were allowed to cure at ambient conditions for 4 hr prior to tests. Each material them was subjected to simulated disk loadings of 6.0, 7.5, 9.0, and 10.5 lb/sq ft until railure or for a minimum of 1 min. Eight ex of JP-4 jet fuel was poured on a material and ignited, and the observation was made whether the material continued to burn after the fuel had been consumed. After the helicopter downwash blast tests had been completed, the materials were subjected to simulated rainfall of 1 in./hr for 1 hr to determine the effects of the rain. The material was then resubjected to the helicopter downwash blast tests. Each material was placed on soil and a known amount of water was placed on it during the waterproof test. The time required for the water to pass through was recorded, and the amount of water that passed through was measured. The materials were subjected to random vehicle traffic tests on a test section 10 by 60 ft with four 15-ft-long items with different soils, loose sand and clayey silt, compacted clayey silt, and heavy clay (one soil type per item). KEYWORDS: Dust control; Expedient surfacings; Materials; Military operations; [Southeast Asia]					
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4. DESCRIPTIVE NOTES (Type of report and Inclusive dates) Final report					
Charles T. McCormick					
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13. ABSTRACT					
This report describes an investigation conducted to fabricated by Harvey Aluminum, Inc., Torrance, C extrusion fabricated from 6061 aluminum alloy artifit the mat was the incorporation of a nonwelded en Individual panels were joined together at the end join investigation consisted of traffic tests to obtain infor experimental mat with project requirements, and to type of end connector. A test section consisting of a the Harvey mat was trafficked with a rolling wheel load conducted using a load cart with a single-wheel load. The test section failed after eight coverages due to the was no other apparent damage to the mat, it was decided in the traffic lane were removed, and the corners for off. The panels were relaid in their original location affailed after 100 coverages due to severe curling an Strength evaluation of the mat indicated that the modifying the end joints indicated that the modified the 25,000-lb load. Therefore, neither the mat as fabilite criterion of 200 coverages. KEYWORDS: Aluminum at a second to the coverage of the coverage of the coverage. The coverage of the co	alifornia. The icially aged to d joint, which the by H-shaped mation for use determine the heavy clay subdisting action of 25,000 lb at the heavy clay and traffic was add dishing alonat, as fabricate with a rated Clay was capably ricated nor the uminum lanvey Alumin	I- by 6-ft n the To cond was an int extruded all in comparin feasibility of grade (rated 6 ctual aircraft that airc infl caused by end the mat and co the mat and co the continued. To ng end joint ed, would sup BR of 4.0. Eve e of supporti the modified m that mat the modified m that mat the modified m that mat that no.	nat is a one-piece hollow ition. The main feature of legral part of each panel. Iminum locking bars. This ig the performance of the fabricating mat with this CBR of 3.6) surfaced with operations. The tests were lation pressure of 250 psi. It-joint curling. Since there continue traffic. All panels and an end joint were cut the section was considered and female connectors, poport 12 coverages of the valuation of the mat aftering about 140 coverages of lat would meet the service s; Extrusions		
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S. ABSTRACT			
This investigation was conducted to evalu	uate the performance	e of AM2 landing	mat from production-lin
fabrication by Washington Aluminum Con			
two clay subgrade items with different str			
AM2 mat. The test section was subjected	d to traffic represen	iting 1600 operati	onal cycles of an aircra
having a 60,000-lb gross weight with a sin			

This investigation was conducted to evaluate the performance of AM2 landing mat from production-line fabrication by Washington Aluminum Company, Inc. (WACO), Baltimore, Md. A test section, consisting of two clay subgrade items with different strengths and one sand item, was constructed and surfaced with the AM2 mat. The test section was subjected to traffic representing 1600 operational cycles of an aircraft having a 60,000-lb gross weight with a single-wheel main-gear assembly load of 27,000 lb and a 30-7.7 tire inflated to 400 psi. Based on the results obtained in this investigation, it is concluded that (a) the AM2 mat will sustain 1600 cycles (188 coverages) of uniformly distributed aircraft operations with a 27,000-lb single-wheel load and 400-psi tire inflation pressure when placed on a clay subgrade having a CBR of 4.0 or greater, (b) the AM2 mat will sustain 1600 passes of a 27,000-lb single-wheel load with 400-psi tire inflation pressure applied in a single path when placed on a clay subgrade having a CBR of 4.2 or greater, with slight core damage occurring in a small percentage of the planks, and (c) the AM2 mat will sustain 1600 passes or 188 coverages of a 27,000-lb single-wheel load with 400-psi tire inflation pressure when placed on a loose sand subgrade.

KEYWORDS: Aluminum landing mats; Traffic tests; [AM2 landing mats, Washington Aluminum Company, Inc.]

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EVALUATION OF DOW CHEMICAL EXTRUDED (MODIFIED MX18-B)	ALUMINUM L	ANDING MA	т .	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report				
5. AUTHOR(\$) (First name, middle initial, last name)				
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The investigation reported herein was conducted designated modified MX18-B, which was produced was also tested at Dyess AFB, Texas, in an integral which was designed and developed by the Dow M	d under contract ated engineering	No. DA-22-07 and service to	79-eng-467 (Neg). This mat est. The modified MX18-B,	

The investigation reported herein was conducted to evaluate an extruded aluminum alloy landing mat, designated modified MX18-B, which was produced under contract No. DA-22-079-eng-467 (Neg). This mat was also tested at Dyess AFB, Texas, in an integrated engineering and service test. The modified MX18-B, which was designed and developed by the Dow Metal Products Division of the Dow Chemical Company, Midland, Michigan, is a one-piece extrusion fabricated from 6061 aluminum alloy artificially aged to the T6 condition. The panels are interlocked along the sides by a hinge-type connector, the components of which are an integral part of the basic panel extrusion. End connectors are composed of extruded connectors welded to the basic panel and consist of an overlap and underlap section secured by a locking bar after individual panels have been joined together. Accelerated traffic tests were conducted on a prepared subgrade, with a rolling wheel load simulating actual aircraft operations. In order that the effects of traffic on the mat could be determined, the mat in item 1 was placed in the normal pattern with the longitudinal (side) joints perpendicular to traffic and in item 2 with the longitudinal joints parallel to traffic. Tests were conducted with a 25,000-lb single-wheel load, with a tire inflation pressure of 250 psi, on a mat-surfaced subgrade with rated CBR's of 3.4 and 3.5 for items 1 and 2, respectively. The modified MX18-B mat in item 1 sustained 350 coverages of traffic, which was equivalent to 670 coverages on a 4CBR subgrade and exceeded the project requirements (200 coverages on a 4-CBR subgrade) by 235 percent. The modified MX18-B mat in item 2 sustained 200 coverages of traffic, which was equivalent to 325 coverages on a 4-CBR subgrade and exceeded project requirements by 62.5 percent. Skid tests were performed on both dry and wet surfaces with a pneumatic-tired, two-wheeled load cart.

KEYWORDS: Aluminum landing mats; Extrusions (Landing mats); Load tests; [Modified MX18-B landing mat]

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EVALUATION OF MO-MAT GROUND COVER FOR USE	IN ARMY DEPO	T OPEN-STOR	AGE AREAS
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Charles J. Gerard			
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13. ABSTRACT This report describes an invest:			
plastic material (STRATOGLAS) molded into	a waffle-lik	e configura	tion for use in Army
depot open-storage areas. The mat, termed	MO-MAT, was	designed a	nd fabricated by Air
Logistics Corp., Pasadena, Calif. Individ	dual panels a	re 50 ft lo	ng, 11 ft wide, and
0.085 in. thick, and weigh 570 lb. A sing	gle layer of	mat was inv	estigated in test
series I on two different subgrades: a we	et sand and a	dry, loose	sand. Traffic was an
plied with a Hyster Model RT-150 forklift	with payload	s of 0, 500	0, 10,000, and 15,000
1b; a 2-1/2-ton M35 cargo truck with 35-ps	si tire press	ure and a g	ross weight of 18,000
1b; a 5-ton M54 cargo truck with 35-psi ti	ire pressure	and a gross	weight of 30,000 lb;
and a Towmotor Model 540-RS forklift with	out a payload	. A total	of 8 cycles was com-
pleted on the test section, with 3870 pass			
areas. The Hyster RT-150 with the 15,000-			
maintenance was necessary on the test sect			
II, the single layer of mat was placed on		-	
3 and one with a CBR of 6 to 7. Traffic v			
with payloads of 0, 5000, 10,000, and 15,0			
to the test area, with a total of 4390 pas			
test vehicle. The most critical load, age	in, was the	Hyster RT-1	50 with a 15,000-1b
payload. Minor maintenance was again nece			
that a single layer of MO-MAT was adequate	•		
areas, except on low-strength material (CI	R of 3 or le	ss). There	was no distinct dif-
ference between the performance of the mat	when placed	on a dry s	and or a wet sand.
KEYWORDS: Fiber reinforced plastic	s; Ground	matting;	Open storage areas
[MO-MAT]			
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19. ABSTRACT	7	e	a soils by specifing
A need exists for soil-stabilizing materia strength, waterproofing, and alleviation o			
field operations. Laboratory and field in			
tary enzymatic materials to determine their			
purposes. Laboratory tests showed that ne			
pable of satisfying requirements as a dust			
penetration treatment. Subsequent tests o			
aid showed no benefits to a clayey silt wi			
requirements for compaction, water-retenti			
roadway test sections, one untreated for c			
enzymatic products, were constructed and t			
ments and observations made during constru			
cant difference between treated and untrea as-constructed and that which developed wi			
tion under traffic on dry surfaces, or abi	lity to supp	ort traffi	c under wet conditions
It is concluded that these enzymatic mater	ials have no	potential	for military soil-
stabilization purposes and it is recommend	ed that no f	urther tes	ts of these materials
be conducted.			

KEYWORDS: Airfields; Dust control;		; Militan	ry roads; Soil
stabilization; Waterproof	fing		
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13. ABSTRACT This project was conducted to find a mean		1 1	C	

vas conducted to find a means of rapidly establishing surfacing on a stable base on tactical assault airfields. Several types of production and experimental membranes were evaluated to determine their ability to withstand abrasive and tearing effects caused by fighter and heavy cargo aircraft tires during ground operations. Related programs and research conducted by the U. S. Army Engineer Waterways Experiment Station were examined to determine existing or potential techniques or materials that could be adapted to the Bare Base requirements for surfacing, and field tests were conducted on the items selected. Materials tested were WX18, a neoprene-coated membrane, T16 membrane, T1 membrane with a double bituminous surface treatment (DBST), and an 11-mil-thick high-strength steel membrane. The materials were subjected to locked-wheel skid and short-radius turn tests using equivalent F-4C and C-130 aircraft wheel loads. Initial skid tests with the F-4C loading were conducted on a subgrade designed for static and rolling F-4C wheel loads. The additional load generated by the locked wheels caused severe rutting and subsequent immobilization of the load wheel. Subsequent tests were conducted successfully in areas with a higher subgrade strength. All materials were subjected to one or more skid tests using F-4C loads. WX18 was also subected to locked-wheel skid tests using C-130 loads and to short-radius turn tests using F-4C loads. The WX18 membrane successfully withstood all the tests, although the neoprene coating was worn off in several areas. The T16, T1 with DBST, and 11-mil steel membranes were ruptured during skid tests with F-4C loadings. From the results of this study, it was concluded that: (a) WX18 can be used as an expedient surfacing material on an assault airfield with adequate soil strength and will withstand the abrasions caused by ground operations of fighter and heavy cargo aircraft, with minor maintenance required in areas with severe abrasions b) T1 with DBST, T16, and 11-mil steel membranes cannot withstand the abrasive effect of locked-wheel kids of fighter aircraft; and (c) the soil strength stipulated by design criteria for assault fields based on static Airfields; Bare base support; Expedient surfacings; Load tests; Membranes (Airfields)

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The test road was constructed as a testing medium that would represent a hastily built road in the TO by using the existing lean clay soil and a minimum of construction effort. The materials to be tested were installed on the test road, exposed to the varying climatological conditions of the Vicksburg area, and subjected to mixed military pneumatic-tired traffic. Vehicles ranged in size from that of the 1/4-ton utility truck (jeep) to the 2-1/2-ton, 6x6 cargo truck. As testing proceeded, data were taken and observations were made for the evaluation of the expedient surfacing materials. It was concluded from the test results that Class 30 Assault Trackway will furnish a load-bearing surface on lowstrength areas and that MO-MAT, when properly anchored, will furnish an expedient surface for marginalstrength subgrades. The results also indicated that T16 and T17 membranes will provide dustproofing and waterproofing mediums on adequate-strength subgrades. Where T16 and T17 membranes were tested as surface drainage overflow sections, they performed well in carrying runoff across the roadway and protecting the subgrade from moisture. The most suitable expedient surfacing material in its price and weight range for adequate-strength subgrades was polypropylene membrane with RS-2K cationic emulsion. Because this low-priced, easily installed combination of materials far outperformed all competitive items during tests, it is considered the most significant development of this project. UCAR-131 (now designated DCA-70), SC-70, and Peneprime proved adequate for lightly traveled areas for short duration.

KEYWORDS: Expedient surfacings; Membranes; Military operations; Open storage areas; Road construction; Road drainage; Roads

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Engineer tests were conducted on a test road covered with an asphalt-impregnated polypropylene membrane at the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., to determine the effectiveness of the combined materials as a dustproof, waterproof wearing surface over adequate-strength subgrades and as an encasing membrane used to form a membrane-enveloped soil layer (MESL) in areas where high water tables exist. The polypropylene-asphalt membrane was installed on the test road, exposed to varying climatological conditions prevalent in the Vicksburg area, and subjected to mixed pneumatic-tired traffic of military vehicles. Vehicles used for testing were a 2-1/2-ton, 6x6 cargo or dump truck and a 5-ton, 6x6 cargo or dump truck, both carrying maximum off-highway loads and having appropriate tire pressures. As testing proceeded, data were taken and observations were made for the evaluation of polypropylene-asphalt membrane as an expedient surfacing material. It was concluded from the test results that (a) polypropylene-asphalt membrane will furnish a waterproof, dustproof wearing surface to any otherwise satisfactory subgrade for periods in excess of 2 years and will sustain many thousands of repetitions of pneumatic-tired convoy traffic without suffering significant damage, and (b) MESL construction is effective in providing a stable roadway in areas having poor drainage and high water tables.

KEYWORDS: Expedient surfacings; Membrane enveloped soil layer; Military operations; Military roads; Open storage areas; Polypropylene asphalt membrane; Road construction; Road drainage; Roads

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AM2 landing mat fabricat of a heavy clay subgrade will be known as AM2 m cycles of an aircraft havir	ted by Harvey Aluminum was constructed and sum od 2. The test section ing a 60,000-lb gross weit re inflated to 400 psi.	m, Inc., Torrance, or faced with the ele was subjected to tright with a single-w	California. etron bear affic repre heel main-	gear assembly load of
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concluded that: (a) the with a 27,000-lb single-wia CBR of 3.6 or greater t connectors resulted in cor of AM2 mat tested previous KEYWORDS: Alumin	heel load and 400-psi ti hroughout the period o nsiderable improvement ously.	stain 1600 cycles (re inflation pressur f traffic, and (b) el in performance of	188 cover, e when pla ectron bea the AM2	ages) of aircraft operations aced on a subgrade having am welding of the end

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Laboratory tests were conducted to evaluate the acci water content and density by the backscatter and dir device and scaler. The nuclear device functioned as	rect transmission nuclear	methods using	a single nuclear	
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sary to know the actual density and water content o	f the test soil. Boxes w	ere fabricated to	o exact dimen-	
sions, filled with uniformly compacted soil, and weig	hed, and actual average	soil density valu	ues were calcu-	

lated. Five soil types were tested to approximate a full range of possible construction materials. Each soil type was tested at eight different densities and water contents. To obtain comparative results, soil densities of each sample were determined by two accepted conventional methods (sand-cone and water-balloon) for determining density in the field. Test results indicated that in situ densities determined by the direct transmission nuclear method using the factory calibration curve furnished with the device were as accurate as densities obtained by the sand-cone and water-balloon methods. The direct transmission nuclear method using a WES-developed calibration curve provided slightly more accurate density measurements than either conventional method. Densities determined by the surface backscatter nuclear method using both the factory calibration curve and a WES-developed curve were not so accurate as those obtained by the conventional methods. Water contents were obtained by nuclear means and compared with actual water contents determined from ovendried samples. Using a WES-developed calibration curve, water contents obtained by the nuclear method were sufficiently accurate for most quality control fieldwork. Water contents obtained using the factory calibration curve were not accurate enough for field use. A test procedure for determining surface layer density and water content of soil by nuclear methods is presented in Appendix A.

KEYWORDS: Measuring instruments; Nuclear methods; Soil density determination; Water content determination (Soils)

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This report describes an investigation coused for the emplacement of earth landing-mat-surfaced runways, are 24 in of equipment, both gasoline and air p clay (4 to 6 CBR), an undisturbed silt (I concluded that the Thor No. 62, a pneitem to be used for anchor emplaceme posthole digger. The average pull require pneumatic wood-boring drill is more recombat Battalion and can also be use employed by the combat engineer troops	a anchors. The earth and long with a 3/4-in, share owered, were tested by 10 CBR), and a sandy extraction wood-boring drillent. The most feasible good to remove the anchors eadily available in the coditor of the field for anchors in the field for anchors.	anchors, used ak and a 4-indriving anchoclay (18 CBI l, would be the asoline-powers after emplace omponents syors, it is recomplacement.	I to anchor the edges of diam helical plate. Ten items ors into a compacted heavy R). From these tests it was the most feasible air-powered and item tested was the Stih ement was 2040 lb. Since the estern for an Army Engineer ommended that this drill be
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13. ADSTRACT			
This report describes an investigation conduct XM20) manufactured by the Dow Chemical Coextruded two-piece aluminum alloy production hollow extrusion fabricated from 6061 aluminum at is similar in design to MX18-B mat; however to add to the design strength of the mat. Both means of a hinge-type connector, the component End connectors are composed of extruded contain and underlap section secured by a locking beinvestigation consisted of traffic tests to obte compare the performance of the XM20 mat with conducted to provide data on the structural promat was traffic tested with a rolling wheel load. The traffic tests were conducted on a prepare aircraft operations. These tests were conducted pressure of 250 psi on a mat-surfaced subgrade AM2, respectively. Tests indicated that when placed subgrade than the subgrade for the subgrad	ompany, Madison, on mat (designated num alloy artificial ver, the internal rib the XM20 and AM atts of which are an nectors welded to ar after individual ain information of the that of the AM operties of the XM at to complete the description with a 25,000-le with initial average aced on a subgrade the production matraffic tests be con	Ill., and, for AM2). The ly ayed to the sand the fem 2 mats are in integral part of the basic par panels have a the XM20 production (20 mats and evaluation of rolling wheels is single-wheels CBR's of 3, with a rated the (AM2) wou	purposes of comparison, and XM20 mat is a one-piece of ETG condition. The XM20 mate connector are thickened terlocked along the sides by of the basic panel extrusion, and and consist of an overlap been joined together. This experimental mat and to mat. Laboratory tests were their component parts. The the design and fabrication. I load that simulated actual of load with a tire inflation 6 and 3.5 for the XM20 and CBR of 4, the XM20 would lid sustain 620 coverages of
KEYWORDS: Aluminum landing mat tests; [XM20 landing	mat]	s (Landin	ng mats); Traffic
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This investigation was conducted to evaluation aluminum landing mats and to compare			
AM2 mat. This landing mat was extru-	ded by the Harvey Alum	inum Co. Torra	once Calif. Three test sec-
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tions were surfaced with 1- by 6-ft and			
with different CBR strength values. Th			
modified 2- by 12-ft mat over a subgra			
the first and second sections. All three			
one was also subjected to single-line tra			
60,000-lb gross weight with a single-wh	eel main-gear assembly l	oad of 27,000 lt	with a 30-7.7 tire inflated
to 400 psi. Based on the results obtain			
2- by 12-ft, and modified 2- by 12-ft n	onwelded aluminum ma	s will sustain 16	000 cycles (188 coverages)
of aircraft operations with a 27,000-lb	single-wheel load and 40	0-psi tire inflati	on pressure when placed
on subgrades having minimum CBR's o	f 3.7. 4.2. and 4.4, respe	ctively, or great	er throughout the period of
traffic; (b) the Harvey 1- by 6-ft nonw	elded aluminum landing	mat will sustain	1600 passes of a 27,000-lb
single-wheel load with a tire inflation p	ressure of 400 psi in a s	ingle path locate	d 1-1/2 ft or more from the
mat end joints when placed on a subgra	ade having a CBR of 4.6	or greater throu	ighout the period of traffic;
(c) the two sections of 2- by 6-ft nonw	relded mat failed early in	the traffic peri	od due to extrusion defects
and not to the nonwelded joint configu	aration; (d) the main diff	erence between	the performance of the 2-
by 12-ft mat and that of the modified	2- by 12-ft mat was that	the modified p	lanks shifted more laterally
during traffic			
KEYWORDS: Aluminum landin	ng mats; Extrusio	ons (Landin	g mats); [AM2
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Unclassified Security Classification DOCUMENT CONTROL DATA - R & D (Security classification of little, body of abstract and indexing annotation must be entered when the overall report is classified) 24. REPORT SECURITY CLASSIFICATION ORIGINATING ACTIVITY (Corporate author) Unclassified U. S. Army Engineer Waterways Experiment Station 26. GROUP Vicksburg, Mississippi JET ENGINE EXHAUST BLAST TESTS ON KAISER XM19 MEDIUM-DUTY LANDING MAT PANELS 4. DESCRIPTIVE NOTES (Type of report and Incinetve dates) Final report

5. AUTHOR(S) (First name, middle initial, fact name) James W. Carr . TOTAL NO. OF PAGES b. NO. OF REFS 27 None September 1969 . CONTRACT OR GRANT NO. 94. ORIGINATOR'S REPORT NUMBER(S) Miscellaneous Paper S-69-35 B. PROJECT NO. 1G664717D556 9b. OTHER REPORT NO(5) (Any other numbers that may be cost good this report) - Task 01

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Washington, D. C.

13. ADSTRACT

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This report describes an investigation conducted to evaluate the effects of high temperatures on Kaiser welded and bonded XM19 mat panels. All panels tested were of the sandwich-type fabrication consisting of an inner core bonded on top and bottom to thin sheets of aluminum. Edge connectors were welded to the top and bottom sheets in one mat and bonded in the other. Panels of each mat were subjected to the exhaust blasts of a J-44 jet engine producing temperatures on the mat surfaces ranging from 300 to 1000 F. A blast impingement angle of 90 deg was used for tests of 1-min duration, and an impingement angle of 5 deg was used for longer blast exposures. Results indicated that both the welded and bonded mats will withstand exposures to blast temperatures as high as 600 F for 1 min without significant loss of strength. It is recommended that these mats be considered capable of meeting the temperature requirement of 300 F for 5 sec as specified for medium-duty landing mats in the Qualitative Materiel Requirement for Prefabricated Airfield Surfacings.

KEYWORDS: Aluminum landing mats; Exhaust blast effects; Jet blast resistant materials; [Kaiser aluminum mats; XM19 landing mat]

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when subjected of an inner core a J-44 jet engin Exhausts at ten 90 deg. Test re 400 F for 1 min tures of 500 F ommended that	cribes an investigation conducted to ever to exhaust blasts of a jet engine. The expended on top and bottom to thin set to simulate exhaust blasts generated apperatures of 300 to 700 F were allow sults indicated that the Goodyear pan with less than a 10 percent decrease or higher caused separation of the top improvement in the bonding technique on or use of the Goodyear all-bonded	e mat is a sandy heets of alumin during takeoffs ed to strike the els successfully in core shear a sheet of the po ue and/or adhes	vich-type fab um. Tests w and landing panels at ar withstood bl nd panel flex anel from the	ricated item consisting vere conducted with s of jet VTOL aircraft. In impingement angle of last temperatures of sural strength. Temperate panel core. It is rec-
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This supplement presents the results of reconstructed or overlaid at Robert Gr. August 1969-May 1970. Selection of CBF materials was based on results of past good performance prediction correlation field facilities at RGAAF, and it is fed discussed in this supplementary evaluate were assigned.	ay Army Airfield R values for sub- evaluation test has been found elt that the mat	(RGAAF) dur grade, subba s on similar by WES pers erials used	ing the period se, and base-course materials. A very onnel for the air- in the construction
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C. D. Burns			
R. W. Grau			
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13. ABSTRACT			
This investigation was conducted to evaluate XM20			
cal Company, Madison, Illinois. The mat, fabricate			
mat except for minor differences in the cross section and connectors to the mat extrusion. A test section			
strength of 4 CBR was constructed and surfaced w	The state of the s		
jected to uniform-coverage traffic representing open			
with a single-wheel main gear assembly load of 27,			
Based on the results obtained in this study, it is o			
cycles (188 coverages) of aircraft operations with a			
inflation pressure when placed on a subgrade havin	g a CBR of 2	2.5 or greater	throughout the period
of traffic, or about 1230 coverages of the same lo	ading when p	aced on a si	ubgrade having a CBR of
4 or greater throughout the period of traffic; the sen	rvice life of th	e XM20 mat	on a 4-CBR subgrade is
about six times greater than that of standard AM2 r			
CBR of 4; and general behavior of the mat in this t	est was greatly	improved by	y the double thickness
of the ribs at the end joints of the planks.			
KEYWORDS: Aluminum landing mats; E			
tests; [Dow Chemical Co.	; XM20 lan	ding mat]	
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Cecil D. Burns				
Denis P. Wolf		•		
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13. ADSTRACT		11110 m 1 01	01/01/1	
This investigation was conducted to evaluate the p	erformance of Dow	XM18-E and Alcoa	AMZ land-	
ing mat. A test section consisting of a heavy-clay	subgrade was cons	in representing 1600	operational	
Dow and Alcoa landing mat. The test section wa cycles of an aircraft having a 60,000-lb gross weig	s subjected to train	ed main-gear assemb	ly load of	
27,000 lb and a 30-7.7 tire inflated to 400 psi.	Resed on the result	s obtained in this in	nvestication.	
it is concluded that: (a) the Dow XM18-E landing	g mat will sustain	1600 cycles (188 cc	overages) of	
aircraft operations with a 27,000-lb single-wheel lo	nd and 400-psi tire	inflation pressure wh	hen placed	
on a clay subgrade having a CBR of 3.3 or greate	r throughout the p	eriod of traffic; this	perform-	
ance meets service requirements set by the Naval	Air Engineering Cen	ter (NAEC); and (b)	the Alcoa	
AM2 landing mat did not meet minimum test requirements set by NAEC.				
KEYWORDS: Aluminum landing mats;	raffic tests:	[Alcoa AM2 1a	anding	
mat; Dow XM18-E landing				
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EVALUATION OF HARVEY AND KAISER PRO	DUCTION AM2 LANDING MAT
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Cecil D. Burns	
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119. ADSTRACT	
This investigation was conducted to evaluate Harve	ev and Kaiser production AM2 landing mat. The
Harvey mat was fabricated by Harvey Aluminum.	Inc., Torrance, Calif., and the Kaiser mat was fabri-
cated by Washington Aluminum Company (WACO)), Enterprise, Ala. Both mats were fabricated from
2-ft-wide extrusions to form 2- by 12-ft or 2- by	6-ft panels and are identified as Harvey and Kaiser
AM2 landing mat. A test section consisting of a	clay subgrade at a strength of approximately 4 CBR
was constructed and surfaced with the two mats,	The section was subjected to uniform-coverage traffic
representing operations of an aircraft having a 60.0	000-lb gross weight with a single-wheel main-gear
assembly load of 27,000 lb with a 30-7.7 tire infla	ated to 400 psi. Based on the results obtained in
this study, it is concluded that: (a) the Harvey	production AM2 mat will sustain 1600 cycles (188
coverages) of aircraft operations with a 27,000-lb	single-wheel load and 400-psi tire-inflation pressure
when placed on a subgrade having a CBR of 3.4	or greater throughout the period of traffic; this
	Kaiser production AM2 mat failed to meet the service
criterion.	
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3. REPORT TITLE			
EVALUATION OF GOODYEAR ALL-BONDED AL	OH MUNIMU.	NEYCOMB	LANDING MAT
4. DESCRIPTIVE NOTES (Type of report and Inclusive dates) Final report			
6. AUTHORIS) (First name, middle initial, last name)			
Charles T. McCormick Gordon L. Carr			
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11. SUPPLEMENTARY NOTES	12. SPONSORING		
	U. S. Arm Washington	ny Materiel (n, D. C.	Command
This report describes an investigation conducted at Station (WES) to evaluate an all-bonded aluminum cated by Goodyear Aerospace Corporation, Akron, the core bonded top and bottom to aluminum skinum edge connectors are also bonded to the top at tion consisted of engineering traffic tests to obtain rication of mat without welds, and (b) evaluate the mat. Laboratory tests were performed to provide mats and their component parts and results indicat mat was placed on a test section with a heavy cla with a single-wheel load of 25,000 lb and a tire it tigation revealed that the Goodyear 4- by 4-ft, all-traffic on a 4.0-CBR subgrade. At the request of turned to Goodyear for modifications. These mod the extruded edge connectors to provide additional the female connector on each end to produce an of the female lip. After these modifications had they were traffic tested. The modified panels sust grade plus 90 coverages on a 4.0-CBR subgrade, widence that fabrication is feasible. However, improvement in fabrication to corners, is needed to provide a mat that will meet KEYWORDS: Aluminum landing mats;	honeycomb of Ohio. The mass with an epand bottom skinformation is eservice life data on the set the mats may subgrade (raflation pressubonded mat value Goodyear per ifications component of the set of the material between made, the single between of the combiner of an all-bot echniques, esp traffic requirements.	ore landing nat is a sand oxy film ad kins and to to (a) determine tructural properties of 250 period of (a) to the special of	mat designed and fabridwich-type structure with hesive. Extruded alumithe core. This investigamine the feasibility of fabrance of the experimental operties of the Goodyear fication requirements. The 3.4) and traffic tested is. Results of this investionally 36 coverages of unused panels were rewelding the corners of and (b) sawing the top of deg to prevent end curl re shipped to WES where affic on a 4.3-CBR subent to 466 coverages on a um honeycomb core mat
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3. REPORT TITLE			
RECONSTRUCTION OF LANDING-MAT TEST FACILITY AND ITS PERFORMANCE DURING C-141A FLIGHT			
TEST PROGRAM, DYESS AIR FORCE BASE, TEXAS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
Final report			
S. AUTHOR(S) (First name, middle initial, last name)			
Cecil D. Burns			
Robert W. Grau			
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evaluation; July 1971. Other reque	ests for the	nis docum	ent must be
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		The second secon	ineers, U. S. Army
	Washington	, D. C.	
13. ABSTRACTThis investigation was conducted to			
the reconstruction of a landing-mat test fac-			
landing-mat runway during C-141A operations	. The test	facility co	onsists of a runway,
6000 ft long and 96 ft wide; a taxiway, 1250 main Dyess runway; and a turnaround taxiway	2 It long an	d bo it wid	the connecting with the
types of landing mat (MX19, AM2, and MX18)	were used to	surface th	ne subgrade. Various
types of waterproofing and dustproofing mate	erials were	applied to	the subgrade, shoul-
ders, and overruns. Based on the results of	btained, con	clusions we	ere drawn as follows.
Aluminum landing mat and ancillary items can	n be removed	from a det	ceriorated airfield at
a reasonable rate and with minimum damage i	f care is ta	ken. The r	removal rates for the
MX19, AM2, and MX18 planks were 330, 380, as	nd 384 sq ft	per man-ho	our, respectively. Ap-
proximately one percent of each type mat and	of the 2-f	t locking t	pars removed from the
test facility were damaged beyond repair.	About 5 perc	ent of the	4-it locking bars,
1-ft adapters, H-rails, and anchors were dar percent of the key locks were damaged beyond	naged and co	ard not be	reused. Although 30
by more careful removal. Inspection of the	membrane us	ed in the	original construction
showed that only the Type 1 Herculite membra	ane was effe	ctive in wa	terproofing the sub-
grade and could have been reused as a water	proofing mat	erial. The	subgrade can be
waterproofed and will drain adequately if it	t is constru	cted at a 2	2.5 percent crown and
surfaced with a polypropylene-asphalt membra	ane. The po	rtions of t	the subgrade and the
soil mattress section that were overlaid with	n T16 membra	ne remained	waterproof
KEYWORDS: Aluminum landing mats; Du	ist contro	l; Materi	ais; water-
proofing; [Dyess Air Ford		bilene, T	exas; MX18,
MX19 and AM2 landing mats	5]		
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EVALUATION OF DOW CHEMICAL EXTRUDED	MIMIMILIA	LANDING I	MAT (XM18E1)
EVALUATION OF BOW CHEMICAE EXTROPES THE			
4. DESCRIPTIVE NOTES (Type of report and Inclusive dates)			
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5. AUTHORIS: (First name, middle initial, last name)			
Dewey W. White Charles J. Gerard			
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	Washington	, D. C.	
13. ABSTRACT	1 11	J:	VM10F1 which was not
This report describes tests of an extruded aluminum	n landing mat	designated 2	and and developed by the
duced under contract DACA39-67-C-0063(NEG). T Dow Chemical Company, is a one-piece extrusion f	abricated from	6061 T6 a	luminum. The mat nan-
els are interlocked along the sides by a hinge-type	connector E	xtruded end	connectors consisting of
overlap and underlap sections are welded to the pa	nel extrusion.	A locking	bar secures these sections
after individual panels have been joined together.	The mat panel	s described	herein were different
from modified MX18-B (which is type-classified as	XM18) panels	in that the	insert tubes in the ends
of the panels were shortened by 3/4 in. and the a	mount of met	al was incre-	ased in the area of the
female connector and first cavity adjacent to this of	connector. Th	e method of	f attaching the end con-
nectors to the mat extrusions was changed to allow	v improved co	rner welds.	Two quantities of
XM18E1 mat (engineer design test and production	test quantities,	with the la	atter taken after approxi-
mately 400,000 sq ft of mat had been produced u	nder the conti	ract mention	ed above) were traffic
tested with a 25,000-lb, single-wheel load (250-psi	tire inflation p	ressure) simi	ulating actual aircraft op-
erations. These tests were conducted to determine	the service life	e, to compa	differences between the
the mat with that of the modified MX18-B, and to	determine ii	there were	grades with rated CRR's
engineer design test and production test mats. The of 4.0 and 3.7 for the engineer design test and pro-	mats were te	mate respect	tively. The engineer de-
sign test mat sustained 1100 coverages, and the pro-	duction test	nat sustained	d 452 coverages (equiva-
lent to 620 coverages on a 4-CBR subgrade). The	engineer desig	n test XM18	BE1 performed 39 percent
better than the modified MX18-B mat (670 coverage	ges on a 4-CB	R subgrade).	The reduction in serv-
ice life of the production test mat was attributed			
members (although they were within tolerance) and			
welds. KEYWORDS: Aluminum landing ma	its; Extru	sions (L	anding mats);
Traffic tests; [Dow landing mats;]		ding mat	
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PAVEMENT TESTS TO PROVIDE FOR THE JUMBO JET	S		
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S. AUTHORIS) (First name, middle initial, last name)			
Richard G. Ahlvin			
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11-12 December 1969			
13. ABSTRACT			
With the advent of jumbo-jet aircraft, as r	epresented b	y the Lock	heed C-5A Galaxy and
the Boeing 747, we are faced with supporting			
aircraft on pavement facilities. To provid			
sections of both flexible and rigid pavements failure under the full matters leading			
c-5A aircraft. The testing program is a jo			
Federal Aviation Administration and is being			
Waterways Experiment Station, Vicksburg, Mi			
corporates items of different thicknesses p			
levels. The test subgrade was constructed			
full 12-ft depth. Both test sections incor measuring instruments at various depths wit			
been loaded not only with the full 12-wheel			
components of the C-5A and 747 gear at vari			See and See and
KEYWORDS: Flexible pavement design (Airfie	elds); Jet ai	rcraft	
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REPORT TITLE		
EVALUATION OF HARVEY NEW-PROFILE AM2 L	ANDING MAT	
DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report		
AUTHOR(5) (First name, middle initial, last name)		
Cocil D. Burns Victor C. Barber		
Robert W. Grau		
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	and the same of the same	Air Engineering Center
	Philade	elphia, Pennsylvania
3. ABSTRACT This investigation was condu	cted to evalua	te new-profile AM2 landing mat by
Harvey Aluminum Company, Torrance, Cal	if. Three met	hods were used to attach end con-
nectors to the main extrusion to form	either 2- by 1	2-ft or 2- by 6-ft planks. These
methods were electron beam welded with	insert (EBI),	electron beam welded without in-
serts (EB), and metal-inert-gas fusion	welded withou	t inserts (MIG). Two test section
were constructed and surfaced with new	-profile mat.	Items I and 2, test section I,
were surfaced with EBI and EB mat, res surfaced with the MIG welded mat. Eac	pectivery. Bo	was subjected to uniform-coverse
traffic representing operations of an	n test section	a a 60 000-lb gross weight with a
single-wheel main-gear assembly load o	f 27 000 1b wi	th a 30x7.7 tire inflated to 400
psi. Fased on the results obtained in	this study i	t is concluded that EBI and EB ma
will sustain 1600 cycles of aircraft o	merations with	a 27.000-lb single-wheel load an
1,00-psi tire inflation pressure when p	laced on a sub	grade having a CBR of 2.6 or
greater throughout the period of traff	ic. or between	700 to 1000 coverages of the sam
loading when placed on a subgrade havi	ng a CBR of 4.	These mats meet the service lit
criterion as required by NAEC. MIG we	lded mat will	sustain 1600 cycles of aircraft of
erations with a 27,000-lb single-wheel	load and 400-	psi tire inflation pressure when
placed on a subgrade having a CBR of 3	.6 or greater	throughout the period of traffic
or 250-300 coverages of the same loadi	ng when placed	on a subgrade having a CBR of 4.
This mat also meets the minimum servic		
		tests; [AM2 landing mat;
Harvey Aluminum, Inc	2.]	
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vicksburg, miss.			
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EVALUATION OF MODIFICATIONS OF AM2 AND XM18	LANDING MAT		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
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5. AUTHOR(5) (Firet name, middle initial, last name)			
Cecil D. Burns			
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	Philadelphia	, Pennsy.	Ivania
19. ABSTRACT			
This investigation was conducted to evaluat	e the performan	nce of A	lcoa AM2 and electron
beam welded XM18 landing mat. The test sec	tion was subje	cted to	traffic representing
1600 operational cycles of an aircraft havi	ng a 60,000-1b	gross we	eight with a single-
wheel main-gear assembly load of 27,000 lb	and a 30x7.7 t	ire infla	ated to 400 psi.
Based on the results obtained in this inves	tigation, it is	conclu	ded that Alcoa AM2
landing mat will sustain 1600 cycles of uni	formly distribu	ited air	crait operations with
a 27,000-lb single-wheel load and 400-psi t	ire inflation	pressure	when placed on a sub-
grade having a CBR of approximately 6 or gr requirements for SATS set by NAEC. Electro	eater. This de	MIR lon	ding met will sustain
1600 cycles of uniformly distributed aircra	ft operations	with a 2'	7 000-lh single-wheel
load and 400-psi tire inflation pressure wh	en placed on a	subgrade	having a CBR of 4.3
or greater. This performance is marginal w	ith respect to	complia	nce with current mini-
mum requirements.	Ion respect to	compa-a	
VEVLOPDC. Aluminum landing mater	waffia tast	. [41-	on: AM2 landing
KEYWORDS: Aluminum landing mats; T	railic tests	, [AIC	oa, Ariz Talluting
mat; XM18 landing mat]			
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EVALUATION OF X420 PRODUCTION LA	UNDING MAT	
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tests; [AM20 land Aluminum Co.]	ow Chemical Company, inum Company, Enterprisimilar to AM2 mat emain extrusion and a st section consistir and surfaced with a ffic representing or gle-wheel main-gear. Based on the resusustain 1600 cycles 00-psi tire inflation ter throughout the purpose of the main-gear. This mat meets the main SATS. The double planks has virtually, there was no signing that of the experiments; Extrusion ding mat; Dow Ch	Madison Division, Madison, Ill., prise, Ala. The mat, fabricated except for the method used to a slight change of the cross secus of one clay subgrade item at a M20 mat. The test section was serations of an aircraft having a assembly load of 27,000 lb with alts obtained in this study, it is of aircraft operations with a on pressure when placed on a subscribed having a CBR of 4 or greater criteria established by NAEC for thickness of the ribs provided by climinated end-joint weld ficant difference in the perform-
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short cover-plate welds and less than the minimum ribs and to compare these mats with T10 and M8 test section, with a rolling wheel load simulating a tained from this investigation, it is concluded that coverages as the T10 control mat when trafficked grade; M8A1 with short cover-plate welds will with control mat when trafficked with a 35,000-lb sing weld mat will sustain about 64 percent of the train on a 6-CBR subgrade and trafficked with a 35,000 metal thickness below the allowable thickness in the cent as many coverages as the T10 control mat was a 3-CBR subgrade; there are no apparent different and that of T10 mat when trafficked on a 5.8-CE metal in the bend radii of mat ribs by approximate the length of the cover-plate welds by the same as control measures be maintained to ensure better quants and that mat not be accepted if the cover-pif the metal thickness in the bends of the ribs is KEYWORDS: Steel landing mats; Trafficked on a 5.8-CE metal in the second of the ribs is the ribs is the second of the ribs is the ribs i	n required thick mats. Trafficatual aircraft: M8 mat wi with a 35,000 histand only 4 le-wheel load offic sustained O-lb single-wheel he bends of the trafficked les in the performance in the performance. It is mainty cover-plate welds do less than the	kness of me c tests were operations. Il withstand 0-lb single-what percent as on a 3-CBR by the T10 el load; M8/me ribs will with a 35,0 ormance of educing the percent is recommende ate welds in not extend thickness all	tal in the bends of the conducted on a prepared Based on the data obonly 19 percent as many neel load on a 3-CBR submany coverages as T10 subgrade; M8A1 short-control mat when placed A1 thin-rib mat with withstand only 63 percolol-b single-wheel load or the thin-rib M8A1 mat specified thickness of less severe than reducing that necessary quality the fabrication of M8A1 the prescribed length or owable.
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Alfred H. Joseph William B. Abbott, Jr.			
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		rters, Stra ir Force	tegic Air Command
IS. ABSTRACT			
Visual observations were made of the pa	avenent and any	signs of c	racking or distress
were noted. Field test pits were locat			
water content, density, and strength ch			
lying base and subgrade. Laboratory to erials. Field testing was conducted at			
CBR, water content, and density measure			
imately 8 in. below the base surface,	and at the surfa	ice of the	subgrade.
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KEYWORDS: Flexible pavement failures	(Airfields); [Ra	mey Air Fo	rce Base, Puerto Rico]
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A need exists for soil treatment materials capable of improving soils by providing strength, by waterproofing, and by alleviating dust in support of military road and airfield operations. Field and laboratory investigations were conducted on a proprietary material (product A) to determine its potential for use as a soil stabilizer for military purposes and its effectiveness in pretreating soil to improve penetration of dust-control materials, e.g. asphaltic penetrative soil binder (APSB). Two test sections, one untreated and one treated with product A, were constructed in an open area and trafficked with a military vehicle and a test load cart. Measurements and observations made during construction and traffic testing showed no significant difference between the treated and untreated sections with respect to strength and ability to support traffic under either wet or dry conditions. For the penetration tests, an open area was bladed to remove all vegetation. Half of this bladed area was pretreated with product A, and then APSB was applied; the other half of the area received only an application of the APSB. Test results indicated that the depth of penetration of the APSB was not affected appreciably by pretreatment of the soil surface with product A. Laboratory tests on representative soil samples obtained from the field test sections indicated no significant alteration of water content or Atterberg limits and only a minor decrease in pH values for treated areas. It was concluded that product A has no potential for military soil stabilization purposes, and it is recommended that no further tests of this material be conducted.

U. S. Army Materiel Command

Washington, D. C.

11. SUPPLEMENTARY NOTES

KEYWORDS: Chemical soil stabilization; Dust control; Materials; Military roads; Waterproofing

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FVALUATION OF SOIL STRENGTH OF UNSURFACED I	FORWARD-AREA	AIRFIELDS	BY USE OF	
4. DESCRIPTIVE NOTES (Type of report and Inclusive dates)				
Final report				
George M. Hammitt II				
6 REPORT DATE	TAL TOTAL NO. O	F PAGES	76. NO. OF REFS	
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10. DISTRIBUTION STATEMENT	AD 709	209		
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II. SUPPLEMENTARY NOTES				
	Washingto		ngineers, U.S. Army	
13. AUSTRACY	<u></u>			
This report describes a method for rapidly area airfields. Through the use of dimens by the U.S. Army Engineer Waterways Experdetermined by measuring rut depths created hieles. This method enables reasonably ac somel without special training and without seil strength existing in the forward area cerning the ability of a particular site to tially, an office study was conducted that method. Then limited field verification to military ground vehicles, i.e. a 1/4-ton Man 3-ton Man, operated on a prepared unsurfind approximately 2 CBR. First-pass rut denated empty and for all but the Man with man of this testing indicated the feasibility pass rut depth caused by military ground we diet the ability of a particular forward-a aircraft traffic. It is recommended that aircraft from actual landing sites on both KEYWORDS: Military vehicles; Mobil airfields	ionless growiment Static by traffic curate asses t the use of sis known, o sustain spectablished ests were could be a 3/4-the code heavy copths were meximum crossof predicting the airfieles. The cody and second static code and second static code and second static code as second curate code as second code as	nd mobility, soil stoof standars of standars of standars of special prediction weighted when the potential the potential the potential the potential the potential the potential to subgrassive of soil straighted to sustand to sustand.	ty parameters developed trength indications are red military ground vescil strength by perinstruments. If the ms can be made concrete traffic. Inimitial of such a ith four standard 2-1/2-ton M35Al, and add with a strength reach vehicle operoading. The results rength based on one-can be used to prein specific small de operations of	
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RESTORATION	OF LANDING-MAT-SURFACED SUBGR	ADES BY GROUT	ING METHOD	os
	Es (Type of report and inclueive dates)			
Final report	seme, middle initial, last name)			
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Victor C. Ba				
. REPORT DATE		70. TOTAL NO. O	F PAGE1	76. NO. OF REFS
June 1970		76		None
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3. ABSTRACT				
Station in or grout for the to develop ed grouts, it was figuration, a cement grouts erately extent the area and landing mat to tested proved tures reached concluded the subgrade dame where expends	tests were conducted at the Under to evaluate the use of pose repair of pumped subgrades of quipment and criteria for their as often possible to restore the and the effective life of the substant of the effective life of the test prevented additional wetting to its original crown configured too low for the asphalts to decrease was confined to a relative itures of materials and man-ho-70 penetration asphalt cement	rtland cemen mder heavy-d r application he landing m test section grade. Thou est section of the subgration. The be stable un mat tempera all be used ly small por urs would no	t and asphauty airfier. By using ats to the could be asphalt when they cade, they der landing tures reachas a repair tion of the toe exorbi	altic materials as ald landing mats and ag portland cement original crown contincreased, though setseted could modeompletely covered could not raise the point of the asphalts g mats when temperated 150 F. It was rechnique when the mat-covered area itant, and that
KEYWORDS:	Asphalts; Grouts; Landi cements; Pumping of pav			d reuse; Portland
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EVALUATION OF KAISER XM19 ALL-BONDED	ALUMINUM	HONEYCOM	MB LANDING MAT
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report			
B. AUTHOR(S) (First name, middle initial, last name)			
Hugh L. Green Carroll J. Smith			
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13. ABSTRACT			
XM19-type landing mat. The mat, which was decical Sales Company, Inc., Oakland, Calif., is a san eycomb core bonded by film adhesives on top and is similar to that of the standard XM19 mat, exceptruded edge connectors are bonded to both the fallong two edges by a hinge-type connection and a connections that are locked together by insertion laboratory and traffic tests to obtain information bonded mat with project requirements and with the fic tests were conducted on a prepared subgrade, operations. The tests were conducted with a sing sure of 250 psi on a mat-surfaced subgrade with revealed that the all-bonded XM19-type mat sustain that had rated CBR strengths ranging from 3.4 to lent 4-CBR subgrade, would total 4840 coverages, 1000 coverages and surpassing the performance of vidual panels was not sudden and was caused by due to core failure. It is recommended that the for the XM19 mat in lieu of the present method KEYWORDS: Aluminum landing mats; XI Kaiser landing mats; XI	signed and devidwich-type structure to alust instead of bearing and the along the adjact of a connector of a connector use in corner performance with a rolling le-wheel load an initial CBR ned 3380 actuals. These of thus greatly of the standard a gradual deput all-bonded me of welding the coneycomb M19 landin	reloped by Kacture compo- minum facineing welded of core. Indivi- cent two edger bar. This mparing the period of standard wheel load of 25,000 lb of 3.9. Re- cal coverages, when the coverages, when the coverages when the coverages when the coverages of the coverages of the coverages of the coverages when the coverages when the coverages of the coverages of the coverages when the coverages when the coverages when the coverages of the coverages of the coverages when the coverage	aiser Aluminum and Chem- beed of an aluminum hon- gs. The design of the mat during fabrication, the ex- dual panels are joined less by overlap-underlap investigation consisted of performance of the Kaiser it XM19 mat. The traf- simulating actual aircraft with a tire inflation pres- esults of this investigation of traffic on a subgrade one equated to an equiva- exproject requirement of Eventual failure of indi- esurface of the panels ication be considered
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TECHNIQUES FOR OVERLAYING DETERIORATED LAI	NDING MAT; Ra	re Base Sup	port
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report			
5. AUTHOR(S) (First name, middle initial, last name)			
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		U. S. Ai	r Force
aircraft traffic. Both test sections we aircraft traffic. Both test sections come on rough deteriorated M6 mat. In the first were evaluated: a thin sand layer, a 4-in layer, and a 4-inthick, membrane-covered jected to simulated F-4C traffic. Best pecushion. The second test section had a 4-with new AM2 over deteriorated M6. The teight different placement configurations we placing 2- by 12-ft mat on a crowned subgrulated F-4C and C-130 test traffic. Best having a 1-ft staggered longitudinal end-jecnter line of the test section. Overall overlay investigation indicate that the befeasible. Practically any type of soil corprotected from surface water. Sands and if fabricated membrane. Gravelly soils must minimum thickness that will provide a smoot considered optimum. Greater thickness may considerable densification and cause subset KEYWORDS: Bare base support; Land [AM2 landing mats]	sisted of a cost test sectionthick sand a lean clay la erformance was inthick least section have used to coade. The test performance value foint pattern findings from sic soil-landings from the used, but he chemically the bearing strong to be used excepted and the used excepted and	ompacted so on, four ty layer, a 4- ayer. The sobtained in clay soil ad a 2-1/2 determine the section was obtained with only in this and siling mat over the soil soils can be a stabilized reface for the soil soil soil so and the soil	il and AM2 mat overlay pes of soil cushions -inthick clay gravel test section was subwith the lean clay l cushion surfaced percent crown, and he optimum pattern for was subjected to simd with a configuration half panels at the another Bare Base materlay technique is cushion must be well e protected with pred. Generally, the the overlay mat is nd, which will exhibit on.
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SOIL STRENGTH CRITERIA FOR OPERATION Bare Base Support	ON OF FIGHTER AIRCRA	FT ON UNSUR	FACED AIRFIELDS;	
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The purpose of this study was to obsary, existing soil strength criter aircraft on unsurfaced airfields. with four test items in each section items and two heavy clay test items sand, lean clay, silt, and heavy clay-hc-type loading, and the results fighter-type aircraft on unsurfaced test sections to simulate the effect traffic tests indicated that existing faced airfields for the rolling load at a indicates that unsurfaced airfierimarily dependent on the angle of	U. S. Ai otain necessary data ria for the operatio Two specially prepa on. Test section 1 c. Test section 2 c lay. These test sec were used to obtain it soils. Skid tests ets of braking on un ang criteria are ade ads of fighter aircr Tields constructed of Tields constructed of	to validate n of high-pred test seconsisted of tions were eriteria for were also surfaced sor quate for u aft. Analy, f soils with	e or modify, if neceserformance jet fighteretions were constructed two lean clay test four items: clayey trafficked with an or operation of conducted on these ils. Results of the se in designing unsursis of the skid test his trength that is	
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EVALUATION OF ALCOA BRAZED AM5	LANDING MAI			
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Cecil D. Burns				
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	Philadel	phia, Penns	ylvania	
13. ABSTRACT				
The investigation reported here Lightweight Brazed AM5 landing Kensington, Pa. Fabrication is manufacturer. A test section, surfaced with the Alcoa AM5 las	mat, fabricated by the ncluded a new process ca consisting of a heavy c adding mat. The test sec	Aluminum Co lled "flip- lay subgrad tion was su	mpany of America, New flop brazing" by the e, was constructed an bjected to traffic	
representing 1600 operational ogross weight with a single-whee	el main gear assembly lo	ad of 27,00	O lb and a $30x7.7$ tir	
inflated to 400 psi, which repr				
was continued until the section				
results obtained in this invest				
1600 cycles (188 coverages) of				
27,000-1b single-wheel load and	400-psi tire inflation	pressure w	hen placed on a sub-	
grade having a CBR of 3.3 or gr	reater. This performanc	e exceeds t	he current minimum re	
quirements for SATS set by NAEC	. The flip-flop brazin	g process r	esulted in considerat	
improvement in the performance	of the AM5 mat over the	performanc	e of Alcoa AM2 mat	
previously tested at WES.				
KEYWORDS: Aluminum land	ing mats; Traffic to	ests: [Al	coa: AMS landing	
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* ABSTRACT Two natural gas burners were used three soils in several moisture concould be fused, the 4- by 4-ft test	U. S. Ar Washingt as heat sources in nditions. Although t samples were not	attempts :	co stabilize samples cas of soil surface
* ABSTRACT Two natural gas burners were used three soils in several moisture concould be fused, the 4- by 4-ft test	as heat sources in nditions. Although t samples were not soil stabilization	attempts : small are stabilized with avai	co stabilize samples as of soil surface. Thermal stabilize stabilize table burners.
Two natural gas burners were used a three soils in several moisture concould be fused, the 4- by 4-ft testion appears to be impractical for	as heat sources in nditions. Although t samples were not soil stabilization	attempts : small are stabilized with avai	co stabilize samples as of soil surface. Thermal stabilize table burners.

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13. ABSTRACT			·	
General criteria for the design and evalual landing mat are presented. Specific crite subjected to operation of the C-141 aircranew method of analysis involving the four pressure, and coverages.	ria are present. These c	ented for r riteria wer	nedium-duty mat re developed using a	
KEYWORDS: Landing mat design; Medium-dut	y landing ma	nts; [C-14]	l aircraft]	
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Alfred H. Joseph		
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Ralph D. Jackson		
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II. SUPPLEMENTARY NOTES	112. SPONSORIN	G MILITARY ACTIVITY
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		re, Maryland
IJ. ABSTRACT		
The primary purpose of this study was to exof the airfield pavements at Godman Army Addetermine overlay requirements for C-130 at located in that portion of the Fort Known county, Kennucky, approximately 6 miles sout to U. S. Highway 31W.	irfield (GAA ircraft oper ilitary rese), Fort Knox, Kentucky, and to ations. Godman Army Airfield is rvation which lies in Hardin
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the study reported herein is one	phase of th	e research	program being con-
ducted at the U. S. Army Engineer Waterways	s Experiment	Station fo	r the purpose of
developing a method for determining thickness	ess requirem	ents for la	nding-mat-surfaced,
membrane-surfaced, and unsurfaced airfields	s. The phas	e of the pr	ogram presented in
this report pertains to the development of	a method fo	r determini	ng thickness require-
ments of soil strengthening layers for land	ding-mat-sur	faced airfi	elds. Five landing-
mat-surfaced test sections were constructed	i and tested	. The subg	rades of the test sec-
tions consisted of heavy clay (1.3 to 3.7 (CBR) of vari	ous thickne	sses. The same mate-
rial placed at a higher strength (3.0 to 8.	.O CBR) was	used as a s	trengthening layer be-
tween the landing mat and subgrade. Test a	section I wa	s surfaced	with MSAl landing mat:
test sections II, III, and IV were surfaced	with XII8	landing mat	: and test section V
was surfaced with AM2 mat. Aircraft traffi	ic with sing	le-wheel lo	ads of 25,000 to
70,000 lb with tire pressures ranging from	112 to 220	nei and tra	ffic with twin-wheel
configurations spaced 32 in. center-to-cent	ton with lon	de rancine	from 56,000 to 70,000
lb and tire pressures ranging from 109 to 1	BOL HOLW 190	cimilated	by means of test load
To and the pressures ranging from 109 to	Loz pai were	ilad CDD	tmter content and
carts. Traffic was applied until each test	section la	lawan	waster contents, and
density of the subgrade and overlying highe	er strength	tayer were	measured before, dur-
ing, and after the traffic tests, and the	condition of	the test s	ections was recorded.
Deflections and deformations were determine	ed throughou	t testing.	An equation for de-
termining the required thickness of soil st	trengthening	layers ben	eath landing mat was
developed.			
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Unclassified Security Classification DOCUMENT CONTROL DATA - R & D (Security classification of title, body of abstract and indexing constation must be entered when the everall report is classified) ORIGINATING ACTIVITY (Corporate author) 28. REPORT SECURITY CLASSIFICATION Unclassified U. S. Army Engineer Waterways Experiment Station Vicksburg, Miss. EVALUATION OF KAISER PRODUCTION ALUMINUM HONEYCOMB LANDING MAT 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report

5. AUTHORIS (First name, middle initial, last name) Challes T. McCormick REPORT DATE A. TOTAL NO. OF PAGES 76. NO. OF REFS March 1971 65 . CONTRACT OR GRANT NO. A. ORIGINATOR'S REPORT NUMBER(S) S. PROJECT NO. Miscellaneous Paper S-71-7 pb. OTHER REPORT NO(S) (Any other numbers that may be seeigned this report) AD 883 189 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. 11. SUPPLEMENTARY NOTES 12. SPONSORING MILITARY ACTIVITY U. S. Army Materiel Command Washington, D. C. The investigation reported herein was conducted to evaluate an aluminum honeycomb-core landing mat designed and fabricated by Kaiser Aluminum and Chemical Sales Company, Inc., Oakland, Calif. The mat is a sandwich-type structure with the core bonded by an epoxy film to aluminum skins on top and bottom. Extruded edge connectors are welded to the skins and bonded to the core. Individual panels are joined along two edges with a hinge-type connector and along the adjacent two edges by overlap/underlap-type connectors that are locked together by insertion of a connector bar. This investigation consisted of laboratory and traffic tests to obtain information to evaluate the performance of the Kaiser mat with regard to project requirements. The traffic tests were conducted with a rolling wheel load simulating actual aircraft operations on mat placed on a prepared subgrade. The tests were conducted with a single-wheel load of 25,000 lb with a tire inflation pressure of 250 psi on a mat-surfaced subgrade with a rated CBR of 4.1. Failures resulted from depression of the surface of the panels caused by core failure and by overstressing the potting compound between the edge connectors and honeycomb core. Results of this investigation revealed that the Kaiser production mat sustained 1434 coverages of traffic, which was equivalent to 1280 coverages on a 4-CBR subgrade, thus exceeding the project requirements (1000 coverages on a 4-CBR subgrade). Based on the results obtained in this investigation, it is recommended that overall quality control measures be employed to eliminate fabrication deficiencies that occur when panels are fabricated at a high production rate. Aluminum landing mats; Honeycomb structure; Traffic tests; KEYWORDS: [Kaiser landing mats] DD FORM 4473 REPLACED DE FORM 1479. 1 JAN 64, WHICH IS Unclassified
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D. ABSTRACT			
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EVALUATION OF FOAMED FLASTICS FOR USE AS PAVEMENTS AND FOUNDATIONS	STRUCTURAL S	JPPORTING LA	YERS IN
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Alfred H. Joseph, Ralph D. Jackson, Thomas	s B. Rosser	III	
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This project was generated by the materials as structural elements of paven where soil strength and aggregate supply tion. The objective of the study was to formance of foamed and/or extended plastitems as structural layers. Tests were comproximately 4.0 pcf and a foamed-in-plastic density of approximately 7 pcf. Various pressure, and thickness were used in the yses were performed on the field data, artion gave the best correlation coefficier foamed plastics can be used as a structure not support conventional construction equiconstruction are too difficult or too expecting and construction procedure, extendand static loads on very low-strength soil	ment structurare not come develop engites, polyeste inducted on page 1 combinations study. Multiple of the study. Multiple of the study	res or as for ducive to con- meering cri er resins, or colystyrene is anne formula a of load, se ciple statis dermined tha a of the stu- special case den convention considered	undation platforms nventional construc- teria for the per- r other similar sys- with a density of tion with a nominal oil strength, tire tical regression anal t a curvilinear equa- dy indicate that es where the soil wil onal methods of . Using the proper

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DESIGN OF UNSURFACED SOIL FACILITIES FOR C	PERATIONS C	F C-5A AIR	CRAFT
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13. ABSTRACT		4 2 4 - 4 - 4	3-4-4-2:3-4
The purpose of the study reported modify, if necessary, existing criteria for			
unsurfaced airfields. Two specially prepa			
trafficked. Test section 1 consisted of a			
tion of surface strength requirements and			
arrangement loaded to 252,000 lb. Test se			
(lanes 1 and 2) of four items each designed	d for evalu	ation of th	nickness requirements.
Lane 1 was trafficked with a 35,000-1b sin			
with the 12-wheel C-5A gear arrangement.			
existing criteria could be used to design	unsurfaced	airfields f	for operations of
C-5A aircraft.			
KEYWORDS: Airfield design; Soil s	trength.	Traffic	tests: Unsurfaced
airfields; [C-5A aircra			coo, onsurfaced
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EVALUATION OF DOW CHEMICAL COMPANY EXTRUDED ALIMINUM	I TWO-PIECE 2- E	Y 12-FT LAND	ING MAT (MX18-D)	
4. DESCRIPTIVE HOTES (Type of report and inclusive dutes)				
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5. AUTHOR(S) (First name, middle Initial, last name)				
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	Washington, D.C.			
13. ABSTRACT The investigation reported herein was cond	ucted to evalua	te an extrude	ed aluminum alloy landing	
mat (designated MX18-D) designed and extruded by the D	low Chemical Com	pany, Midland	i, Michigan. The mat, which	
was fabricated by Dow's subcontractor, Washington Alum two-piece partially hollow 6061-T6 aluminum alloy pane				
along their longitudinal edges to form a 2-ft-wide pan	el.) The panel	s are interle	ocked along the sides by a	
hinge-type connector, the components of which are an i				
aluminum edge connectors are welded to the basic panel by a locking bar after individual panels have been joi	ned together.	an overrap a	ration consisted of engi-	
neering traffic tests to evaluate the design and perfo	rmance of the L	low MX18-D mai	t for compliance with crite-	
ria specified in the Department of the Army approved Q	qualitative Mate	riel Require	ment (Q:R) for Prefabricated	
Airfield Surfacings dated 14 April 1966 (this QMR was				
proved on 2 April 1968). The traffic tests were condu- craft operations on mat placed on a prepared subgrade.				
25,000 lb with a tire inflation pressure of 250 psi on				
ing Ratio (CBR) of 4.0 for both item 1 (mat oriented w				
direction of traffic) and item 2 (mat oriented with internal ribs of extrusion parallel to the direction of				
traffic). Results of this investigation indicated that the Dow MX18-D mat on items 1 and 2 sustained 704 and 500 coverages, respectively, of traffic, thus exceeding the original project requirements of the 1966 QMR				
(200 coverages on a 4.0-CBR subgrade). The service life of the MM18-D mat placed with the internal ribs of				
the extrusion parallel to the direction of traffic was only 71 percent as long as the life of the mat placed with the internal ribs perpendicular to the direction of traffic. The longitudinal weld did not contribute				
significantly to mat failure. Laboratory tensile stre				
sheets, ribs, and bottom sheets of panels of MX18-D mat. Results of these tests revealed that the tensile				
strength was within the specified requirements. The revised QMR for expedient surfacings now specifies that				
a medium-duty mat must sustain 1000 coverages of a 25,000-1b single-wheel load on a 4.0-CBR subgrade and weigh no more than 4.5 1b per square foot of placing area. Since the MX18-D mat weighs 5.3 1b per square				
foot of placing area and did not sustain 1000 coverages, no further tests of this item are recommended.				
KEYWORDS: Aluminum landing mats; Extrusions (Landing mats); Laboratory tests; Traffic tests; [MX18-D landing mat, Dow Chemical Co.]				
tests; Traffic tests; [MX]	18-D Landii	ig mat, D	low themical to.]	
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	ARVEY ALUMINUM 1- BY 12-FT EXTRUDED AL DERLAP END CONNECTORS	UMINUM LIGHT-DU	TY LANDING MAT		
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Hugh L. Green Charles T. McCo					
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13. ABSTRACT					
designed and fathollow extrusion are interlocked of the basic extrum inserts using secured by a local aboratory, trained as a lightenia and trafficked wasing the C-130 pressure of 100 Harvey light-duris equivalent tomat, i.e. 1000 of the top skins. I vicinity of the mat was 370 sq is curfaces were 0, surfaces was not served.	on reported herein was conducted to evericated by Harvey Aluminum Company, In a fabricated from 5063 aluminum alloys along the sides by means of a hinge-turusion. End connectors, composed of any the electron beam (EB) welding methocking bar after individual panels have file, and skid tests to obtain informativity landing mat. Traffic tests were with a rolling wheel load simulating an aircraft loading, which consisted of spsi, on a subgrade with a rated CRR of ty mat sustained 450 actual coverages on 367 coverages on a 4-CBR subgrade. Failure bottom skins, and internal vertical means welds even though voids were present if the man-hour. The average coefficient of and 0.73, respectively. The tire we the considered significant. Laboratory the minimum physical requirements stiput	ne., Torrance, Cartificially age green connector, to extruded connect od, consist of content of the constant of the conducted with the conducted w	calif. The ladd to the T6 cohe components for swelded to overlap and un gether. The investment of 30,000 of this invest subgrade with for the cover occurred in the some areas. In obtained from skidding	by 12-ft mat is a one-piece ondition. The mat panels of which are integral parts the basic panel and alumiderlap sections that are nvestigation consisted of rvey mat for potential on a prepared subgrade he tests were conducted 1b with a tire inflation tigation revealed that the a rated CFB of 4.2, which age criterion for light-duty he mat body with breakage in at the end joints in the The placement rate of the m skid tests on wet and dry on both the wet and dry	
KEYWORDS:	Aluminum landing mats; I tests; Light-duty landing Aluminum Co., Inc.]				
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5. AUTHOR(S) (First neale, middle Initial, last name)				
Gordon L. Carr				
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landing mat, which is nearly identical variaffic tests were conducted on three variations. The type 2 mat (Dl connector wisingle-wheel load for 2000 coverages on equates to 1785 coverages on a subgrade the Qualitative Materiel Requirement (Ql essentially equal to the service life of ties of the type 3 mat (Dl connector wishigh-strength subgrades. Prior test dat stand 50 coverages in rainy weather, but on subgrades of low and high strength, which a total of 55.24 in. of rainfall (ing rates for the types 1 and 2 mats were on a flat subgrade. The maximum placing was 66.4 sq ft per man-hour on a 2 perceives defined as the produced only slight tire wear, ture test without loss of structural structure test without loss of structural structure.	with standard XM ersions of the XM erspectively, of the type 3 mat respectively, over the the type 3 mat respectively, over the type 3 mat respectively, over the type 3 mat respectively, over the type 3 mat respectively. The type 3 material the trowned subgering tools. The type 3 material the type 4 material the type 3 material the type 4 material the type 5 material the type 5 material the type 5 material the type 6 material the type 6 material the type 6 material the type 6 material the type 7 material the type 8 material the type 8 material the type 9 material the ty	(M19 water, ding streading streading streading streading streading streading streading with several similar with stook of the typical streading with stook on both we antiskid on both we to the several structures structure.	laboratory, blast, and proof mat. The type 1 sses and breaks in the tood a 25,000-lb, CBR of 4.1, which. This exceeds a 4-CBR subgrade and is waterproofing capabili mat would not withdefeld 642 and 1668 coverage month period during as recorded. The placman-hour, respectively, ype 3 mat in three test ever, this rate was incoating provided a et and dry surfaces od the blast temperatals. The seal bars in and were not reing removal.	
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EVALUATION OF MO-MAT 158 AS LIGHT-DUT	Y LANDING MAT			
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Carroll J. Smith				
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This investigation was condumaterial molded into a waffle-like conflicts were conducted on four special bolts placed in predrilled noles. The craft loading on three prepared subgrances of traffic when placed on subgratively. Therefore, the MO-MAT 158 doment (GMR) for a light-duty mat (1000 panels were assembled at an average research the minimum QMR placing rate representatively. Therefore, the coefficients of friction obtained from the QMR coefficient of friction range tests was negligible, but small piece dry-skid tests. The longitudinal and connections; also, the longitudinal panels were believed when aircraft tour fields during installation, the anche considered feasible for field use. It ight duty landing the plastics: Traffic the communications: Light duty landing plastics: Traffic	cted to evaluate of more of Mo-MM vashing to ted to evaluate of mo-MM vashing to teat of more of more of more of the coverages on a set of 150 so fruitment of friction of 0.4 to 0.8. so fruiber were transverse join oint plastic number of mat was hodown short of orage system use t is recommended ut landing the mats; Plastic mats mats mats mats mats mats mats mats	emy Materie ton, D. C. MO-MAT, a use as life 158 conne were conduit strength 96, 184, a Cualitativ 4-CBR subgit per man-hisq ft per skid tests in on a wet Tire wear peeled from a runway a still that no fit that no fit that no fit.	reinforced plastic sht-duty landing mat. eted by nut plates wit eted using C-130 airs. Results of this nd 500 actual cover-0. 6.5. and 10. respece Materiel Recuire-rade). The MO-MAT 158 our. which does not man-hour. The average were 0.30 and 0.45, surface falls below during the wet-skid om the tire during the provide waterproof re not strong enough to h-CPN subgrade. During due to possible difinvestigation is not urther consideration be	
This investigation was condumaterial molded into a waffle-like conflicts were conducted on four special bolts placed in predrilled holes. The craft loading on three prepared subgrainvestigation indicated that MO-MAT 1 ages of traffic when placed on subgratively. Therefore, the MO-MAT 158 doment (QMR) for a light-duty mat (1000 panels were assembled at an average result of the minimum QMR placing rate regulations of friction obtained from the QMR coefficients of friction obtained from the QMR coefficient of friction range tests was negligible, but small piece dry-skid tests. The longitudinal and connections: also, the longitudinal jecure the bolted overlapping panels to havards created when aircraft touc considered feasible for field use. In the part of	cted to evaluate of more of Mo-MM vashing to ted to evaluate of mo-MM vashing to teat of more of more of more of the coverages on a set of 150 so fruitment of friction of 0.4 to 0.8. so fruiber were transverse join oint plastic number of mat was hodown short of orage system use t is recommended ut landing the mats; Plastic mats mats mats mats mats mats mats mats	emy Materie ton, D. C. e MO-MAT, a use as life 158 conne were condumt strength 96, 184, a CBR's of h. Qualitativ h-CBR subgit per man-h sq ft per skid tests in on a wetter pecked from a runway a sei that no fit landing T 158 lar	reinforced plastic ent-duty landing mat. eted by nut plates wit eted using C-130 airs. Results of this nd 500 actual cover-0.5. and 10. respece Materiel Recuirerade). The MO-MAT 158 our. which does not man-hour. The average were 0.30 and 0.45, surface falls below during the wet-skid om the tire during the provide waterproof re not strong enough to h-CMR subgrade. During due to possible did investigation is not urther consideration be	

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13. ABSTRACT	L				
The investigation reported herein was condu-					
using membrane-enveloped soil layers (MESL)	as structura	al element	s in flexible		
pavements and (b) investigate the performan	ce of KESL c	onstructio	on under multiple-wheel		
heavy gear load (MWHGL) traffic. A test se					
MMHGL test section at the U.S. Army Engine- the existing 4-CBR clay subgrade. The test					
item 1, the granular subbase and base and the	section con	concrete	used in the original		
construction were replaced with a 24-inth	ick MESL. In	item 2,	the granular subbase		
and base courses were replaced with a 21-in	thick MESL	that was	overlaid with a 3-in		
thick layer of asphaltic concrete. In item	3, a 15-in.	-thick MES	SL was used to replace		
the original granular subbase material. The	is item was	then over	laid with a 6-inthick		
crushed-stone base and a 3-inthick asphal	tic concrete	surface o	course. The soil used		
for the MESL consisted of a lean clay (CL) sity at a water content slightly less than	and was compl OF 55 ontimu	m. The co	ornacted soil was com-		
plutely encased in a waterproof membrane.	The subsurfa	de membrai	ne was a 6-mil-thick		
untinuous sheet of clear polyethylene. The	e surface wa	s formed i	in place utilizing		
polypropylene cloth that was field-treated	with a catio	nic emulsi	ified asphalt (ASTM		
designation C-RS-2). The test items were subjected to traffic with a simulated C-5A					
main-gear 12-wheel assembly with a 360,000-16 gross load and a 75,000-16 single-wheel assembly. The performance of the test items under traffic showed that the concept of					
utilizing MESL's as structural elements in pavement construction is feasible. The 24-					
inthick EESL constructed over a 4-CBR subgrade withstood more traffic with the C-5A					
leading than did a conventional pavement item of the same total thickness during the					
rightal MMMGL tests. Further work is needed to develop construction techniques and					
methods of constructing granular bases and asphaltic concrete layers over MESL's.					
KEYWORDS: Flexible pavement design (Airfields); Membrane enveloped					
soil layer; Multiple wheel landing gears; Subbases					
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Owen O. Thompson				
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13. ABSTRACT Model to protetime				
Model-to-prototype unsurfaced, landing-mat-sur	similitude requirements			
tures for airfields. An ext	tensive literature search	h of model	studies was first con-	
ducted. The general concep-	t of dimensional analysi	s in the an	rea of pavement systems	
was then introduced, follow	ed by identification of	important '	variables, development	
of pi terms, and formulation	n of similitude requirem	ents for to	rue and distorted models	
A compensated model that di	storts one or more desig	n condition	ns in such a manner that	
the distortion is compensate facilities are also discussed				
the desired size of the mode				
configurations, loads, speed	ds, and scale ratios. I	t is recomm	mended that a model be	
constructed for testing a s	ingle-wheel assembly tra	veling at 1	low speeds at this stage	
of study.				
KEYWORDS: Airfields;	Landing mat design;	Mathema	tical models;	
	sign; Similitude; U			
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of two dust-control materials, a polyviny asphalt-neoprene emulsion (CANE), and two ical, that were used to apply the PVA and apply the PVA and apply the PVA and apply the PVA and two ical, that were used to apply the PVA and apply the PVA and cANE with no reinforcing to climate. The materials were allowed to c subjected to the simulated airblast of a traffic by 1/4- and 2-1/2-ton vehicles. i.e., instability in storage, excessive r were observed during testing. The pneuma ease, but the mechanical distributor enco Based on the results of the investigation tions are considered warranted: (a) Actificiencies in PVA and CANE. (b) Fibergla terial until equipment capable of placing and in the required quantities can be devimproving the distributor pump should be dust-control materials that may be expose (e) Film-forming dust-control materials to be reinforced. KEYWORDS: Asphalt emulsions; Cons	I acetate (Pi distributors CANE. Both gs, with fiber sand and claure for 4 hr CH-47 helicop Only minor de unoff, and to tic distribution thered diffireported her serim should be as serim should be serim should be to be a serim should be	(A) water eres, one pneum distributor relass scrin after place other and a conficiencies ackiness after sprayed deulty in sprayed ald be used fiberglass sealoped. (c) (d) All edge ould be and a subjected	mulsion and a cationimatic and one mechan- rs were used to m reinforcing, and an intermediate ement and were then C-130 aircraft and to in the FVA and CANE, ter 4 hr curing time, both materials with praying the CANE. collowing recommenda- to correct the de- as reinforcing ma- at the required rates) Investigations for es of film-forming chored by burying, to traffic should
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An investigation was conducted to evaluate landing mats. Traffic and field tests we comparing the performance life of the an quirement for landing mat. Various turn ors, half panels, repair panels, closure and turndown adapters were tested. Engis surfaced prepared subgrades, with a roll operations. The turn adapters, access a withstood 1100 coverages of the required panels sustained a maximum of 152 covera along the diagonal overlap connectors. many coverages as were sustained during sure panels sustained only 50 coverages successful in the field tests. It is readapters, starting connectors, and half (b) the XM19 repair panel design be stud service life of the item; (c) the requirits practicability in regard to design, (d) the edge anchor and modified anchor KEYWORDS: Anchors (Fasteners);	ere conducted cillary items adapters, acc panels, edge neer design teing wheel load dapters, start load on a 4-CBF are the first test on a 4-CBF sufficient and improvement for a cleost, and need attachments be Landing mat	to obtain with the pleas adapt anchors, sts were simulating connected subgrade ir panel on a 4-Congrade. The plead as sements be osure panel in field accepted as; Subgrades; Subgrades;	information for use in performance life re- ers, starting connect- anchor attachments, conducted on mat- ng actual aircraft etors, and half panels de. The initial repair; failures occurred sustained over twice as ER subgrade. The clo- he anchors proved turn adapters, access tandard items; made to increase the el be studied as to construction; and as standard items.	
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KEYWORDS: Flexible pavement performance and evaluation (Airfields); [Fort Polk Army Airfield, Fort Polk, Louisiana]

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This report describes application of a dust sion control. Application conditions were application of the DCA-1295/Fiberglass systible with the dust-control materials. A sof vegetation in this area, tumbleweed, is after the dust-control materials had been the treated was on slopes ranging from IV on Mi vehicles) was not possible in the area; the of the IV on Mi slopes were covered by cablinging and the second present was used for reinforcing. Been ric impossible, a portion of the project stravorable wind conditions would allow Sandiplace. Based on the results obtained in the warranted: (a) the soil sterilant used (Mi stabilization system discussed herein at the stabilization system discussed herein at the sasier to apply on steep alopes than the 25 lb), and (d) cutter guns, considered up the ARES project where small areas can be of	unusual in several ways can after it was ascerts oil sterilant was deemed ineffective in controll slaced would have destred to 1V on 2H. Vehiculates and wire mesh; there area, though steeper, was epersistent high wires was sprayed with DM is investigation, the fiver and is a second to play and is employed to the second to play and the second to play and the second to play and the second to t	. A soil ste ined that the necessary be ing erosion. yed the syste traffic (e. ere applied u fore, short g was relativel ds made place -1295 and leftee the reinfo ollowing come th fiberglass s will contro he weight of ects, are ide	rilant was used prior to sterilant would be compat- cause the most common type Vegetative growth occurring m. Most of the area to be g. that of distributor sing hand-held hoses. Most lass fibers were used for y uncluttered, and fiber- ment of the fiberglass fab- tunreinforced until more reing and secure it in lusions are believed and DCA-1295; (b) use of th 1 erosion; (c) chopped glass the packages (30 versus
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The U. S. Army Engineer Waterways Experiment Station was directed to make a comprehensive review of publications containing information about existing methods for measuring skid resistance of rigid and flexible pavements. Based on this review, a skid-resistance measuring device was selected for use by the Army. Literature reviewed included reports of investigations by various agencies of the U. S. Government as well as by State governments, foreign governments, and private research and development organizations. These reports described equipment that ranged from simple inexpensive devices to complex systems costing many thousands of dollars. The review represents the first phase of a study of the skid resistance of pavements. Follow-on studies will include field testing of the selected method for measuring skid resistance and an investigation of treatments to improve the skid resistance of pavements where needed. The aim of this overall study will be to (a) select a skid-resistance measuring device for flexible and rigid pavements, (b) use results obtained therewith to establish when the surface of the pavement needs upgrading, and (c) provide a maintenance procedure for improving the skid resistance of pavement to an acceptable level.

13. ABSTRACT

KEYWORDS: Concrete pavements; Flexible pavements; Measuring instruments; Skid resistance; State of the art studies

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Field measurements were made to determine the velocity of the horizontal and vertical downwash flow beneath the rotor of a UH-1H helicopter. Maximum downwash velocities measured during 7-sec periods were as follows:

		Aircraft	Position	Maximum	
Direction	Distance from Center of Rotor	Hover Height	Heading*	Downwash Velocity	
of Flow	Rotation, ft	ft_	deg	mph	Remarks
Horizontal	41	10	360	59	
Vertical	29	. 30	270	30	6' above ground

*Referenced to instrument line:
360-deg heading, aircraft facing line.
270-deg heading, aircraft rotated 90 deg left.

KEYWORDS: Blast effects; Helicopters; Velocity

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This paper presents techniques for analyzing	ne relative	guntacing y	equirements for
container-handling equipment. Its primary			
evaluating the effects of vehicle character			
procurement of specific vehicles. At the			
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that have had a major influence on equipmen			
equipment is broken down into five major co			
yard gantries, mobile cranes, and tractor-			
gories plus the LARC LX amphibian were eva-			
faces. The Waterways Experiment Station Vo			
ability to operate on beaches and soils of	limited str	ength. The	criteria for opera-
tion of aircraft on unsurfaced areas were t	used for med	ium- and hi	igh-strength soils,
and criteria for the design of military roa	ads and airf	ields were	employed in the anal-
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exceptionally large amounts of engineering			
equipment such as the large mobile cranes.			
suited to beach operation although it would	d be possibl	e for some	items to operate with
limited payloads on dense sands. The M8Al	light-duty	landing mat	was found to be
satisfactory only for two types of equipment	nt and for n	eriods of	imited duration. The
study also pointed out the need for a bette	er understan	ding of tre	offic patterns within
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U. S. Army Engineer Waterways Experiment Station	Unclassified
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3. REPORT TITLE	
EVALUATION OF HARVEY ALUMINUM 1- BY 12-FT EXTRUDED I END CONNECTORS	JGHT-DUTY LANDING MAT WITH SYMMETRICAL BUTT-TYPE
4 DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report	
5. AUTHORISI (First name, middle initial, last name)	
Hugh L. Green	
6 REPORT DATE	78. TOTAL NO. OF PAGES 76. NO. OF REFS
October 1972	65 . 9
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	U. S. Air Force Weapons Laboratory,
	Air Force Systems Command Kirtland Air Force Base, N. Mex.
13. ABSTRACT	
The investigation reported herein was conducted to designed and fabricated by Harvey Aluminum Company.	eveluate an extruded aluminum alloy landing mat that was Inc., Torrance, Calif. The 1- by 12-ft mat is a one-
piece hollow extrusion fabricated from 6063 aluminu	m alloy artificially aged to the T6 condition and weighs
2.51 lb per square foot of placing area. The mat p	anels are interlocked along the sides by means of a ntegral parts of the basic extrusion. End connectors,
which are composed of 6061-T6 extruded aluminum con	nectors with integral inserts welded to the basic panel
using the electron beam welding method, consist of locking her after individual panels have been loine.	symmetrical butt-type sections that are secured by a d together. The investigation consisted of laboratory,
traffic, and skid tests to obtain information for w	se in evaluating Harvey mat for potential use as a
light-duty landing mat. The test data reported her mat as established in the revised Qualitative Mater	ein were evaluated against the criteria for light-duty
tests were conducted with the mat placed on a prepa	red subgrade and trafficked with a rolling wheel load
simulating actual aircraft operations. The tests w	ere conducted using the C-130 aircraft loading, which tire inflation pressure of 100 psi, on a subgrade with
an average CBR of 3.2. Results of this investigation	on revealed that the Harvey light-duty mat sustained 160
actual coverages of traffic on a subgrade with a ra	ted CBR of 3.1, which is equivalent to 430 coverages on
4-CBR subgrade. This falls short of the coverage	criterion for light-duty mat, i.e., 1000 coverages on the mat body, with breakage in the top skins, bottom
skins, and internal vertical members. No failures	occurred at the end joints in the vicinity of the welds
man-hour. The average coefficients of friction obt	areas. The placement rate of the mat was 350 sq ft per ained from skid tests on wet and dry surfaces were 0.57
and 0.58, respectively. The tire wear resulting fr	om skidding on both the wet and dry surfaces was not
considered significant. Laboratory tests conducted exceeded the minimum physical requirements.	on the mat indicated that the 6063-T6 alloy generally
	; Traffic tests; [Harvey landing
	, marrie tests, marvey randing
mats] `	
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3. REPORT TITLE				
EVALUATION OF XM20 AND XM20E1 LANDING MATS UNDER HEA	AVY-DUTY LOAD			
4. DESCRIPTIVE NOTES (Type of report and Inclusive dates)				
Final report				
5. AUTHOR(S) (First name, middle initial, last name)				
Carroll J. Smith				
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		Materiel Comm	mand	
	Washington,	р. с.		
13. ABSTRACT				
This report describes investigations conducted to e				
by the Dow Chemical Company, Madison, Ill. These my	ats were design	ated as XM20	and XM20E1, and they are	
one-piece hollow extrusions fabricated from 6061 alm XM20El mat is basically identical in design with the	uminum alloy ar XM20 mat with	the exception	ged to the 10 condition. The	
in both male and female connectors were incorporated	in the XM20 d	esign to prov	wide additional strength in	
these areas. Both the XM20 and the XM20El mats are	interlocked al	ong the sides	s by means of hinge-type	
connectors, the components of which are an integral				
composed of extruded connectors welded to the basic secured by a locking bar after individual panels ha				
sisted of traffic, skid, and laboratory tests to ob-	tain informatio	n for use in	evaluating the mats for	
potential use as heavy-duty landing mats. An AM2 re				
to evaluate its performance under heavy-duty load or medium-duty mat in a previous investigation. The to				
criteria for heavy-duty mat as established in the re				
tests were conducted with the mats placed on a prepare				
simulating actual aircraft operations. The XM20 and				
445 and 617 sq ft per man-hour, respectively. These 150 sq ft per man-hour. The average weights of the	placing rates	exceeded the	6 00 and 6 05 lb rer square	
foot of placing area, respectively. The traffic te				
with a tire-inflation pressure of 250 psi on a mat-	surfaced subgra	de with init:	ial average CBR's of 3.6 and	
4.0 for the XM20 and XM20El mats, respectively. Re	sults indicated	that when pl	laced on a subgrade with a	
rated CBR of 4.0, the XM20 mat would sustain 610 co 620 coverages. These results did not meet the QMR:	verages of traf	110, and the	ges on a 4.0-CBR subgrade	
for a heavy-duty mat. The AM2 repair panel sustain	ed 124 coverage	s on a subgra	ade with a CBR of 3.6. The	
average coefficients of friction obtained from wet	and dry skid te	sts were 0.3	3 and 0.52, respectively,	
for the XM20 mat and 0.34 and 0.56, respectively, for	or the XM20El n	at. The coef	Oh to 0.8. The coef-	
wet surfaces for both mats fell below the QMR coeff ficients of friction of 0.38 and 0.52 for the XM20	mat were determ	ined in a pre	evious investigation wherein	
it was evaluated as a medium-duty mat. Laboratory	tests conducted	on both mat	s indicated that the 6061-T6	
alloy exceeded the minimum physical requirements st	ipulated.			
KEYWORDS: Aluminum landing mats;	[Dow land	ing mats	; XM20 and XM20E1	
landing mats]				
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U. S. Army Engineer Waterways Experiment Station		Unclas	
Vicksburg, Miss.	D CA CLOSS	2b. GROUP	
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EVALUATION OF DOW CHEMICAL EXTRUDED TRU	SS-WEB LANDING MAT		
4. DESCRIPTIVE NOTES (Type of report and Inclusive dates)			
Final report			
5. A. SHOR(5) (First name, middle initial, last name)			
Dewey W. White, Jr.			
6. REPORT DATE	78. TOTAL NO.		7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT	110 1	13 721	
13. ABSTHACT	Washing	rmy Materiel	
The investigation reported herein was conducted without end connectors and truss-web aluminum & Midland, Mich. The truss-web extrusions were cout end connectors and were 1-1/2 in. thick, 2 the extrusions. After the 2- by 24-ft truss-web -9-ft landing-mat panels, and these were evaluation of the mat consist get-blast, and temperature-impingement tests; a service life and performance of the truss-web raffic tests were conducted on quantities of perpendicular to the direction of wheel travel must placed in the standard placement pattern (itin of wheel travel); and 2- by 9-ft mat place ternal ribs parallel to wheel travel). The truss-web extrusions withstood 1534 coverages tional 2466 single-line passes on a 5-0 CBR (to f 2000 coverages (equivalent to 1612 coverages mat in the standard placement pattern before for everages on a subgrade with a 4-0 CBR) were as the hinging action of the mat allowed the subgrade-strength tests conducted on samples tal landing mat revealed that the tensile strength study and testing are recommended in order to will eliminate the requirement for membrane to the subgrade. This water penetration causes the KEYWORDS: Aluminum landing maters is the standard manding maters and the standard manding maters and testing are recommended to cause the Standard Placement for membrane to the subgrade. This water penetration causes the KEYWORDS: Aluminum landing maters and the standard manding maters a	alloy heavy-duty lands one-piece multi-hollow ft wide, and 2h ft leeb extrusions were tested. The mat is a one 2 ft wide, and 9 ft leeb extrusions were tested. The mat is a one 2 ft wide, and 9 ft leed of traffic tests; sand laboratory tests. mat in accordance with the 2- by 2h-ft extrus of load eart) without side connectors and is ed in a longitudinal paffic tests were conduing—wheel load simula (1h10 coverages on a sotal of 4000 passes on so on subgrade with a silure occurred. Two pplied on the truss—we rade to flow outward; ection was considered ken from the top sheet of the material was we develop a waterproof be placed beneath the subgrade strength; Extrusions S; Dow Chemic	ing mat design w 6001-76 alum one. No anticated under transported and transpor	ned by Dow Chemical Company, whom alloy extrusions with- skid material was applied to affic, Dow supplied 2- by - hollow extrusion fabricated antiskid material on the top who are not seen to be a supplied to evaluate the tive Materiel Requirement. at ribs and side connectors ors; 2- by 9-ft truss-weh perpendicular to the director (side connectors and in- 24-ft-long extrusions and aircraft operations. The a h.O CBR) and an additate the test section. A total applied on the 2- by 9-ft rages (equivalent to 200 longitudinal pattern before or of the test section. To roughness. Laboratory bettom sheet of truss-web led requirements. Further mass-web landing mat, which ent water penetration into e.
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REPORT TITLE			
TRIP TO EUROPEAN RESEARCH INSTITUTI	IONS RELATIVE TO W	ORK OF SOIL	S AND PAVEMENTS
LABORATORY			
DESCRIPTIVE NOTES (Type of report and Inclusive date	•)		
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S. J. Johnson			
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J. ABSTRACT			
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Research institutes visited were:	University of Dur	ham, Durham	, England; Norwegian
Geotechnical Institute, Oslo, Norwa			
Sweden; Danish Geotechnical Institu	ite, Copennagen, L	enmark; Uni	versity of Cambridge
Cambridge, England; Engineering Geo	ology Division, In	perial Coll	ege of Science &
Technology, London, England; Soil 1 & Technology, London, England; U. S	Mechanics Laborato	David Comor	t Group Furonean
Research Office, London, England; U. Research Office, London, England;	s. Army Research o	Frairearin	a Laboratory Liebor
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, REPORT TITLE			
STRENGTHENING OF KEYED LONGITUDINAL CONSTR	UCTION JOINT	S IN RIGID	PAVEMENTS
4. DESCRIPTIVE NOTES (Type of report and lactuetye dates)			
Final Report April 1971 - May 1972			
b. AUTHOR(5) (First name, middle initial, last name)	-		
Robert W. Grau			
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	Systems I		d Development Service
	Washingto	on, D. C.	20591
ADSTRACT	Air Force	Weapons L	aboratory
	Kirkland	Air Force	Base
F	Albuquer	que, New Me	xico 87117
			(000)
The rigid pavement test section was constr			
trafficked with a 360-kip 12-wheel assembl			
evaluate the performance of keyed and dowe			
rigid airfield pavement under multiple-who			
tigate the feasibility of strengthening ex			
ings from this investigation are as follow			
rigid pavements on medium-strength (k = 20	0 - 400 pci) foundatio	ns was marginal; (2) i
is feasible to strengthen the keyed joints	in existing	g rigid pav	ements that are founde
on low- to medium-strength (k < 4.00 pci) m	aterials and	l are in go	od condition if the
airfield is scheduled for MWHGL aircraft t			
joints in existing rigid pavements constru	cted on high	n-strength	(k > 400 pci) or sta-
bilized soil foundations will probably per			
traffic; (4) a sand-filter course beneath			
minimizing subgrade pumping; (5) a 6-int	hick stabil:	ized base c	ourse placed over a
low-strength (k < 200 pci) subgrade is ver			
capacity of a 10-inthick nonreinforced P			
construction joints in rigid pavements con	structed on		
subgrades (k < 200 to > 400 pci) performed KEYWORDS: Construction joints; Multiple w			

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HEPOAT TITLE			
CONSTRUCTION OF FIBROUS REINFORCED CONCRE AIRPORT, FLORIDA	TE OVERLAY T	EST SLABS,	TAMPA INTERNATIONAL
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5. AUTHORIS (First name, middle initial, last name)			
Frazier Parker, Jr.			
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	Washin	gton, D. C.	20591
3. AUSTRACT	•		
This report describes the planning and co	onstruction of	of two fibro	us reinforced
	The test sect	tions includ	ed 4- and 6-in thick
concrete overlay test sections at TIA.		to one of	the primary N-S run-
overlays located on a currently used para	allel taxiway		
overlays located on a currently used para	after about o	one month's	traffic, and the
overlays located on a currently used para ways. The test sections were inspected a condition of the overlays is described he	after about orein. Concl	one month's lusions base	traffic, and the
overlays located on a currently used para ways. The test sections were inspected a condition of the overlays is described he of the test section indicate that fibrous	after about or erein. Concl s reinforced	one month's lusions base concrete ca	traffic, and the d on the construction n be produced in a
overlays located on a currently used para ways. The test sections were inspected a condition of the overlays is described he	after about of the control of the co	one month's lusions base concrete ca Procedures	traffic, and the d on the construction n be produced in a

KEYWORDS: Fiber reinforced concrete; Overlays (Pavements); Rigid pavement construction; [Tampa International Airport, Tampa, Florida]

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Lewis E. Link, Jr.			
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	Washington, D. C.		
1) ABSTRACT			
A study was made to determine the	reasibility of using	g an airb	orne taser profitometer
system to rapidly appraise selecte	ed unprepared Landing	g sites.	tions Insor profiler
rou, hness was made in terms of mic	erorelier, slope, and	1 obstrue	cions. Laser profitton
eter data were collected at 12 to	st areas that provide	ea variat	ions in surface geometr.
vegetation cover, and other natura	al and man-made feati	ares. In	e inherent characteris-
ties of the laser profilometer sys	stem and the extrance	ous noise	present in the laser
profilometer output prevented a di	irect quantitative co	omparison	of the laser profi-
lometer output and reference prof:	iles of the terrain.	To over	come this difficulty,
a procedure was developed for inte	erpreting the laser	profilome	ter output to obtain
an interpreted terrain profile for	r comparison with re	ference p	rofiles. A total
of 17 specific terrain features at	the 12 test areas v	vere chose	en for analysis of the
capabilities of the laser profiles	goton cycton Coman	cirons of	the dimensions of the
features as measured on the interp	meter system: comper	lac and re	former modiles show
reatures as measured on the interp	reted terrain profit	callle a m	reliable arrow of the in
that the height of terrain feature	se coura oc measured	when a pr	lead marile line
and a maximum error of approximate	ely 12 in. The abili	ity of the	Laser prolitometer
system to measure terrain slope wa	is evaluated by compo	aring meas	surements of the change
in elevation over a 328-ft interva	al as obtained on las	er profi	lometer outputs and
photogrammetric reference profiles	. The laser profile	ometer sys	stem did not accurately
measure terrain slope in direction	(+ or -) or magnitu	ide.	
			.1
KEYWORDS: Field tests; Las	ers; Microgeometr	y; Prof	ilometers; Terrain;
Unsurfaced runway	y performance and	l evalua	tion
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CONDITION SURVEY, GRAY ARMY AIRFIELD, F	ORT LEWIS, WAS	HINGTON	
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Philip J. Vedros			
Ralph D. Jackson			
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1. SUPPLEMENTARY NOTES	Office,	Cmief of Ex	
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3. ABSTRACT			
The purpose of this report is to presen Gray Army Airfield (GAAF), Fort Lewis, was limited to general observations, an ment facilities.	Washington, du	rimg October	1971. The inspect:
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KEYWORDS: Flexible pavement performance performance and evaluation			
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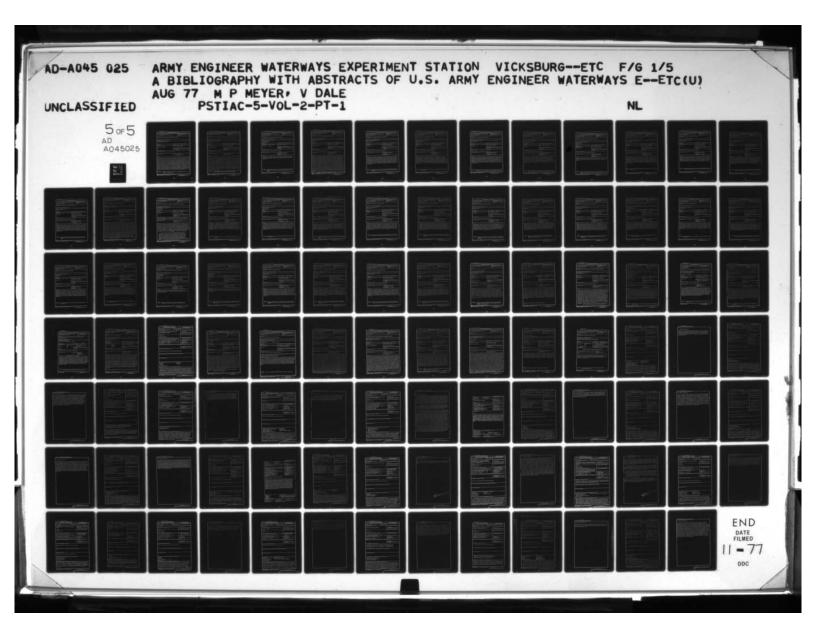
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U. S. Army Engineer Waterways Experiment Station Vicksburg, Miss.		2b. GROUP	1ed	
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3. REPORT TITLE		L		
STUDY OF BEHAVIOR OF BITUMINOUS-STABILIZED PAVEMENT	LAYERS			
4. DESCRIPTIVE NOTES (Type of report and Inclusive dates)				
Final report				
5. AUTHORISI (First name, middle initial, last name) Cecil D. Burns				
Richard H. Ledbetter				
Robert W. Grau				
5 REPORT DATE	78. TOTAL NO. O	FPAGES	7b. NO. OF REFS	
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	Washington			
The investigation reported herein was conducted to	(a) compare the	performance c	of bituminous-stabilized	
base and subbase materials with that of unbound gra	nular materials	as used in th	e original multiple-wheel,	
heavy gear load (MWHGL) test section and (b) determ	ine the differen	ce in perform	ance between a high quality	
bituminous base constructed of crushed aggregate an				
crushed material. A test section was constructed w	ithin the existing	ng MWHGL test	section at the U.S. Army	
Engineer Waterways Experiment Station (WES), utilize tion consisted of four test items. Items 1 and 2 w	ora constructed	to a thickness	s of 15 in and items ?	
and 4 to a total thickness of 24 in. In item 1, t	he granular base	and subbase	used in the original con-	
struction were replaced by a bituminous-stabilized	base constructed	of the uner	shed gravelly-sand subbase	
material used in the original MWHGL test section.	Cement filler of	6.5 percent	was used with the aggregate	
to improve the gradation. Item 2 was identical wit	h item 1, except	for the 12-i	n. base, which was con-	
structed of a high quality asphaltic concrete conta	ining crushed li	mestone. In	ntem 3, the unbound	
crushed-stone base used in the MWHGL test section w and the gravelly-sand subbase in the bottom 15 in.	of the structure	was stabiliz	ed with asphalt cement.	
Item 4 was identical with item 3, except that the g	ravelly sand was	not stabiliz	ed. A 3-inthick surface	
layer of high quality asphaltic concrete was constr	ructed over all t	est items. T	The test items were sub-	
jected to traffic with a simulated C-5A main gear 1 75,000-lb single-wheel assembly. The results of te	2-wheel assembly	with a 350,0	200-1b gross load and with a	
bound base and subbase materials was superior to the	at of similar pa	vements const	cructed of unbound granular	
materials used in the original MMNGL test section a	it the WES, the q	unlity of age	gregate used in the	
bituminous base courses had a significant effect on	pavement perfor	mance, and th	ne greatest benefit from	
bituminous stabilization was in upgrading the quali				
KEYWORDS: Aggregates; Base course				
Flexible pavements; Gra	nular mate	rials; La	ayered systems;	
Subbases; Subgrades; Tr	affic test	S		

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cles in the theater of operations (TO) and costs are required in obtaining ma building techniques are needed to redu The objective of this investigation wadures for employing a membrane-envelope road construction in the TO. Construction was built containing both MESL and conconducted, and construction requirement stration MESL road was then constructe for rapidly evaluating membrane materi designed and constructed. Various surfacility. The test facility is a vast plying traffic. The results of the in be used in MESL base course road const surface and subsurface water intrusion grained soil to 95 percent of CE 12 deport traffic operations of a 5-ton, 6x for highway travel. Sheets of 6-mil-t brane for the MESL. Of the upper memb containing a single layer of product D 55,000 coverages of traffic with no fa	. In many instate terial and produce the construct is to develop cord of soil layer (ME tion techniques waterproof membrate to for MESL based to test the ME als and other suffacing materials improvement overtigation indirection and can Compaction of mity (AASHO T-16 military dumphick polyethyler ranes tested, the performed the book of the construction and the cons	mces, sizab acing suitab acing suitab acing suitab acing suitab acing suitab acing suitab acing to as a bas for encapsu anes were d ase courses courses wer acings for acings fo	chle construction effort the roads. New road and costs of these roads bechniques and processe course to allow rapid thating in situ or loceveloped. A test road at Traffic tests were edetermined. A demonals, a test facility military roads was at using this new y used methods for applications of the successfully from in. MESL of finesis sufficient to supplied as the lower memonly propylene membrane
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Co SA sirons fi	live flight support test opera	ations were	conducted	during the period
7 May through	5 June 1970 to determine the a	ability of t	the C-5A to	operate from un-
surfaced land	ling areas. The U.S. Army Engi	ineer Waterw	ays Experi	ment Station supported
the Air Force	Weapons Laboratory, at their reffects of the aircraft operat	request, in tions on uns	obtaining surfaced la	nding areas. The test
site was loca	ited at Harper Lake, California	, near Edwar	ds Air For	ce Base. The surface
soil at the t	est site was lean clay. It was gross loads of 571,000 lb and	s found that	: During	these tests, the C-5A
erated on lea	in clay subgrades with strength:	s of 15 CBR	or more; h	owever, the tests did
not permit ev	aluation of the aircraft capabi	ility on uns	surfaced so	ils of lower strength.
The minimum t	curning radius required for the was about 85 ft. The dust cle	ouds formed	during air	craft ground opera-
tions constit	uted visibility and maintenance	e problems.	It is rec	ommended that an
evaluation of	C-5A aircraft operations be ed of support-area airfields than	onducted on	a soil wit	h characteristics
obtained from	this test should then be supp	lemented wit	th laborato	ry tests, model tests,
and theoretic				
KEYWORDS:	Aircraft landing areas;	Cargo air	craft: C	lays: Soil
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DVALORITOR OF CHOOSING REAL PORT AND CO.				
4. DESCRIPTIVE NOTES (Type of report and inclusive dates Final Report)			
5. AUTHOR(\$) (First name, middle initial, last name)				
Gordon L. Carr				
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	Was	hington, D. C.		
13. ABSTRACT				
This report describes an investigation to eve and fabricated by Goodyear Aerospace Corporat posal dated 6 May 1968. The medium-duty mat epoxy film adhesive to aluminum top and bottom with a similar adhesive to the top and bottom edges with a hinge-type connection and along that were locked together by insertion of a commander of the service life and performance of the medium tests were performed to determine the mechanic results indicated that the materials in them ducted with a rolling wheel load, simulating tests were conducted using a single-wheel load mat-surfaced subgrade with a rated CER of 3.5 fic under the above-stated conditions, which mut failed to meet current requirements of 10 tained almost twice as many coverages as a pripanels resulted from a gradual depression of tween the core and skins and by overstressing	tion, Akren, Chio, a was a sandwich-type mskins. Extruded a skins and to the connector bar. The connector bar. The 18 square feet per mid skid tests were commedity mat as specifical properties of the mat met the specifical aircraft operations and of 25,000 lb with 3. The Goodyear med is equivalent to 85,000 coverages on a leveriously tested Goothe surface of the	is a result of the structure with aluminum edge core. Individual ges by overlappanel dimension ann-hour, respected to obtain the structure of the mat panels and requirements of mat placed a tire-inflation—duty mat six occurrence on the core of the subgrade dyear all-bonder panels caused by	the Government request for p n a honeycomb core bonded by connectors were also bonded al panels were joined along -/underlap-type connections ns, weight, and placing rate ctively. The weight per squ ain information for evaluati t requirements. Laboratory and their component parts, a . The traffic tests were co on a prepared subgrade. Thi ion pressure of 250 psi on a satained 622 coverages of tr a 4.0-CBR subgrade; thus, t e. The medium-duty mat sus- ed mat. Failure of individu by feilure of the adhesive b	two

[Goodyear aluminum mats]

KEYWORDS: Aluminum landing mats; Honecomb structures; Traffic tests;

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1 REPORT TITLE		1	
EVALUATION OF DOW CHEMICAL COMPANY EXTRUDED AL	JUMINUM 4-PIECE 4- BY	4-FT LANDI	NG MAT (MX18-E)
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report			
5. AUTHOR(5) (First name, middle initial, last name)			
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13. ABSTRACT			
The investigation reported herein was co CMX18-E) designed and extruded by the Dow Chemicated by Dow's subcontractor, Washington Alumipiece, 6061-T6 aluminum alloy panel. (The panto form the 4-ft width.) The panels when place hinge-type connectors, which are integral part of extruded aluminum overlap and underlap comeseures these connectors after individual panetests to evaluate the service life of the Dow of the Army (DA) approved Qualitative Materiel dated 14 April 1966. The traffic tests were operations on mat placed on a prepared subgrad 25,000 lb with the tire inflated to 250-psi profer item 1 (MX18-E mat oriented with its internated CBR of 4.0 for item 2 (MX18-E mat with itained 460 coverages on item 1 and 580 coverages for item 2 on a 4.0-CBR subgrowerings on a 4.0-CBR subgrowering on a 4.0-CBR subgr	cal Company, Midland thus Company (MACO), tel consisted of four tel consisted of four tel are joined along as of the basic panel, so of the basic panel, the tel consisted that are welded as the part of the state of the tests were conducted with a roll tel. The tests were cressure on a mat-surf mal ribs perpendicul its internal ribs parties on item 2, which grade. These coveraging of the MK18-E m of the mat with the i rate of 263 sq ft pends; Extrusion	Michigan. Enterprise. L2-inwid two edges be extrusion. ed to the be This inve- he criteria or Frefabri- ing wheel le conducted with aced subgra- ar to the de allel to tra- is equivalence es exceed to the transport of the man-hour, as (Land	The mat, which was fabri- Ala., is a h- by h-ft, four- e extrusions welded together y interlocking male and femal The adjacent edges consist acic panel. A locking bar stigation consisted of traffi specified in the Department cated Airfield Surfacings ond that simulated aircraft th an F-hC tire loaded to de with a rated CBR of 3.6 irection of traffic) and a affic). The MX18-E mat sus- nt to 710 coverages for item to 700 coverages for jetm the GMR service life of 200 ith the internal ribs paralle s perpendicular to traffic, which exceeds the minimum ing mats); Traffic
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This report describes an investigation of with modified male and female hinge-type	connectors. The MX19 ma	maig aluminum	and fabricated by Kaiser
Aluminum and Chemical Sales, Inc., Oakla	nd, Calif., was a sandwic	h-type struct	ure composed of an aluminum
honeycomb core bonded by an adhesive to tors were welded to the sheets and bonde	top and bettom aluminum s	heets. The e	extruded aluminum edge connec- els were joined along two
edges by a hinge-type male/female connec	tion. The adjacent edges	were joined	by an overlap/underlap con-
nection secured by a locking bar. In pr	evious engineer design te	sts of MX19 m	at, although results in-
dicated that the mat exceeded by 175 per 200 coverages, a fairly consistent failu	re mode was established a	long the femu	le connector. Field per-
formances in Vietnam indicated that a lo	nger service life would t	e required th	an that specified by the QMR
and that sustained by the MX19 mat. Sin 1000 coverages, the manufacturer's design	n efforts were directed t	oward extendi	ng the service life of the
MX19 mat. Subsequently, modifications w	ere made in both the male	and the fema	le connectors. The MX19 mat
with modifications in both connectors we female connector was designated MX19-C.			
information on the effectiveness of the	modified connectors in ex	tending the s	service life of the mats and
on the skid-resistance and tire-wear cha were conducted on a test section with ra	racteristics of the mat s	for the MY10-	ectively. The traffic tests
using a 25,000-1b single-wheel load with	a tire-inflation pressur	e of 250 psi.	Results of the investiga-
tion indicated that the MX19-B would sus a h.O-CBR subgrade. Thus, the service 1	tain 750 coverages and th	ne MX19-C, in	excess of 2050 coverages on
(200 coverages) and by approximately 4 t	imes that of the MX19 mat	(550 coverag	ges). The coefficients of
friction of the mat surfaces during dry	and wet conditions were (0.32 and 0.22,	respectively. These coeffi-
cients of friction were lower than those not meet the QMR performance specificati	on of a 0.40 to 0.80 rang	ge for coeffic	cients of friction on both dry
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The purpose of this report is to present the results of a condition survey performed at Ellsworth Air Force Base (EAFB), South Dakota, during 6-9 April 1972. The following three major areas of interest were considered in this condition survey: (a) The structural condition of the primary airfield pavements. (b) The condition of pavement repairs and the types of maintenance materials that have been used at this airfield. (c) Any detrimental effects of frost to the pavement facilities. This report is limited to a presentation of visual observations of the pavement conditions, discussion of these observations, and pertinent remarks with regard to the performance of the pavements. No physical tests of pavements, foundations, or patching materials were performed during this survey. The annual pavement maintenance plan for EAFB is presented in Appendix A.

KEYWORDS: Flexible pavement performance and evaluation (Airfields); Rigid pavement performance and evaluation (Airfields); [Ellsworth Air Force Base, South Dakota]

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The purpose of this report is to present the results of a condition survey performed at Altus Air Force Base (AAFB), Oklahoma, during 14-17 May 1972. The following three major areas of interest were considered in this condition survey: (a) The structural condition of the primary airfield pavements. (b) The condition of pavement repairs and the types of maintenance materials that have been used at this airfield. (c) Any detrimental effects of frost to the pavement facilities. This report is limited to a presentation of visual observations of the pavement conditions, discussion of these observations, and pertinent remarks with regard to the performance of the pavements. No physical tests of the pavements, foundations, or patching materials were performed during this survey.

KEYWORDS: Flexible pavement performance and evaluation (Airfields); Rigid pavement performance and evaluation (Airfields); [Altus Air Force Base, Oklahoma]

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11. SUPPLEMENTARY NOTES

The investigation reported herein was conducted to evaluate the effectiveness of stabilized structural layers (lime- and cement-stabilized layers) in pavement performance and to determine the comparative performance between a full-depth high-quality crushed stone and the stabilized layers during simulated aircraft traffic. The comparative performance between the stabilized layers and similar pavements consisting of unbound granular base and subbase materials previously tested in the Multiple Wheel Heavy Gear Load (MWHGL) test section was also determined. A test section was constructed within two items of the existing MWHGL test section at the U. S. Army Engineer Waterways Experiment Station in order to utilize the existing 4-CBR clay subgrade. The test section consisted of four 24-in.-thick items. The structural layers above the subgrade for the respective items were: item 1, a 15-in.-thick lime-stabilized lean clay layer overlaid with 6 in. of crushed stone and 3 in. of asphaltic concrete (AC); item 2, a 15-in.-thick cement-stabilized lean clay layer overlaid with 6 in. of crushed stone and 3 in. of AC; item 3, a 21-in.-thick crushed stone base and 3 in. of AC; and item 4, a 21-in.-thick cement-stabilized clayey gravelly sand layer overlaid with 3 in. of AC. Items 1 and 2 were trafficked with a 360-kip 12-wheel assembly, a 160-kip twin-tandem assembly, and a 50-kip single-wheel assembly; items 3 and 4 were trafficked with a 200-kip twin-tandem assembly and a 75-kip single-wheel assembly. Mixed traffic was applied to item 4 with the 360-kip 12-wheel and 75-kip single-wheel assemblies. KEYWORDS: Crushed stone; Evaluation; Flexible pavements; Layered

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criteria for the design of landing-mat-sur	faced airfie	lds to be	subjected to opera-			
tions of the C-5A aircraft. A specially p	repared test	section w	as constructed and			
trafficked. The test section consisted of	one test la	ne that in	cluded four items:			
two designed to evaluate strength requirement	ents for lan	ding-mat-s	urfaced soil and two			
designed to evaluate thickness requirements items were trafficked with one main gear o	f the C-5A a	ircraft ()	2-wheel gear arrange-			
ment) loaded to 360 kips. The analysis of	the test da	ta obtaine	d in this investiga-			
tion indicated that the existing criteria	would have t	o be modif	ied for application			
to the design of landing-mat-surfaced airf	ields for us	e by the C	-5A aircraft.			
CAUTIO	N					
The design procedure and criteria	developed i	n the repo	rted in-			
vestigation are pertinent only to free	-rolling loa	ds of flot	ation-type			
aircraft and thus apply to the design	of facilitie	s such as	taxiways,			
aprons, etc. The effects of high-spee	d braking op	erations o	f the C-SA			
aircraft on runways are still under st	udv. Until	the condit	ions lead-			
ing to failure of AM2 mat (similar to	XMIO mat) un	aer nign-s	olled.			
ing on landing roll-out of the C-5A ca landing of this aircraft on mat cannot	be accommod	ated with	certainty.			
KEYWORDS: Cargo aircraft; Landin			um duty landing			
mat; Traffic tests; [C		ittj				
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13 ABSTRACT	1				
This investigation was conducted to develor tables) for buried pipe beneath flexible—and unsurfaced airfields subject to operat theater of operations. Present design probased on the present design practices were under various loadings. Stress-at-depth of surveys, and tests of pipe subjected to the and the field behavior was compared with a quirements were developed for rigid and fles subjected to operations of the C-5A and ot ments are intended for use in conjunction AFM 86-3, Vol II, "Planning and Design of ater of Operations," but because of their applicable to all airfields.	and rigid-particles were actices were actices were actices were actions for the confidence of the conf	cerement, la C-5A and cereviewed, dused to p ll-scale lo ther loads havior. Man buried ben t. These p ment of the asses, and l	anding-mat-surfaced, other aircraft in the and computer programs predict pipe behavior oad cart tests, field ings were analyzed, inimum pipe-cover remeath airfields to be pipe-cover require- a Army TM 5-330/ Heliports in the The-		
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1 April 1971 through 1 April 1973		
Y. T. Chou, R. H. Ledbetter		
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The instrumentation data of the multiple-reduced and analyzed. By incorporating traffic, relations between load and paven was developed to compute the measured strents; based on the method, the stresses types of airfield pavements under differ between computed parameters and traffic as well as from many other pavement tests. Based on the instrumentation data, the privalid for flexible pavements. Attempts wingle-wheel loads for MWHGLs by many difference in the strength of th	wheel heavy gear load the performance of test tent response were esta tesses and deflections and deflections can be tent loads. Correlation terformance data from a conducted by the Corp tinciple of superpositivere made to reevaluate	t pavements under ablished. A method of the test pave- e computed for similar ns were established the MWHGL test section ps of Engineers.
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February 1971-August 1973			
W. R. Barker; W. N. Brabston; F. C. Towns	end		
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Unsurfaced roads

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Data were collected by the U. S. Army Engineer Waterways Experiment Station to characterize sections of gravel roads and courses selected for testing in conjunction with a U. S. Department of Agriculture, Forest Service, tire wear-road deterioration study. The primary purpose of the study reported herein was to describe, in quantitative terms, the surface and subgrade of selected sections of unpaved road surfaces in Oregon representative of logging roads in the western United States. Data also were collected on one road and one test

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The high intensity of aircraft operations closing of runways and other pavement face properties of the pavement necessary to ever the introduction of multiple-wheel heavy a creasing number of aircraft operations has carrying capability of pavement structures mance. The objective of this study was to the required pavement properties that can tion and interference with aircraft operations aperture technique was developed to obtain determine moisture, density, and classific 6-indiam core hole. Equipment and test the small aperture method are shown to agree test procedures. A nuclear density device discussed, and data are presented that she aperture tests were not found to have a test were cut in half. The tests can be perfor aircraft can operate over the 6-indiam of KEYWORDS: Airfields; Nondestruct Pavements; Test proced	ilities in c valuate its gear load ai s emphasized s and to ant o develop te be used wit tions. As a n CBR streng cation of th procedures ree well wit e developed ow the accur ime advantagemed between core hole.	rder to med load-carrying reraft count the need to incipate ful chairman result of the values are pavement are discussed those obtespecially acy of the terminal traffic on traffic on	sure the physical one capability. Also, also with an ever into know the load- cure pavement perform determination of a of pavement destructhis study, a small and samples used to components through a sed. Data obtained by ained by conventional for this study is device. The small cower requirements perations, and most
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U. S. Army Materiel Command 5001 Eisenhower Avenue Alexandria, Virginia 22304 2.46518421 The investigation reported herein was conducted to evaluate 2- by 9-ft, truss-web, heavy-duty landing mat supplied by the Dow Chemical Company. The mat was traffic-tested to evaluate its performance reintive to the requirement that heavy-duty landing mat be capable of sustaining 1000 coverages of heavy- duty loading (50,000-16, single-wheel load (SWL), 250-pai tire inflation pressure) when placed on a h-CRR subgrade. Traffic tests were conducted to determine the performance of the truss-web mat. These traffic tests were conducted on prepared subgrades, with a rolling wheel load simulating actual aircraft condition A 50,000-16 SWL with a 250-pai tire inflation pressure was used. The first quantity of mat tested was designated initial production mat. This mat failed after 250 coverages due to tire hazards caused by spl eight began at the female 1-lock corners and extended along the female connectors. The subgrade was rate a k.d. CAR. Several design modifications were studied, resulting in tagering of the female connectors at the panel corner for a traffic test in an effort to improve the performance of the mat. This tra- fic test, designated modified production test, was conducted under the same loading conditions used for the initial test. In the first phase of this test, the mat was placed on a subgrade rated at h.O. CRR and cub- lected to 10ho coverages without test section failure. In addition to this traffic, two miditional phases of traffic were applied prior to mat test section failure. In addition to this traffic coverages, Alterequence and an additional line of panel and joints in the standard traffic lane received 100 percent of the traffic coverages, Alterequence and points in the standard traffic lane received 100 percent of the traffic coverages, Alterequence and additional line of percent of subgrade rated at 4.0 CRR. Hume 3 traff was a centification of fines I traffic until mat failure. A total of 300 addition	U. S. Army Material Command 5001 Eisenhower Avenue Alexadaria, Virginia 2230h 2. Ausinaci The investigation reported herein was conducted to evaluate 2- by 9-ft, truss-web, heavy-duty landing mat supplied by the Dow Chemical Company. The mat was traffic-tested to evaluate its performance relative to the requirement that heavy-duty landing mat be capable of sustaining 1000 coverages of heavy-duty landing for the first part of the truss-web mat. These traffic tests were conducted to determine the performance of the truss-web mat. These traffic tests were conducted on prepared subgrades, with a rodding wheel load simulatine actual aircraft condition A 50,000-1b SML with a 250-psi tire inflation pressure was used. The first quantity of mat tested was designated initial production mat. This mat failed after 250 coverages due to tire humanis caused by spleight legan at the female 1-lock corners and extended along the female connectors. The subgrade was rate the panel corners. This consisted of cutting the corners of the female connectors off for approximately 2 in a long sine connector at an angle with the panel corners. The contractor soffice sufficient panels with the tapered corners for a traffic test in an effort to improve the performance of the mat. This traffic test, destinated sofficed sufficient panels with the tapered corners for a traffic test in an effort to improve the performance of the mat. This traffic test, destinated sofficient panels with the tapered corners of a traffic test in an effort to improve the performance of the mat. This traffic test, the sufficient panel of traffic were applied prior to mat test section failure. In addition to this traffic, two miditions used for traffic working failures are placed to 100 percent traffic coverages. All required for the again proposed proving from a confidence of traffic confidence for the material confidence of panel end joints, and the mat successfully sustained these overages on an additional line of panel end joints, and the mat successfully sustain	G. DISTRIBUTION STATEMENT			
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CEYWORDS: Heavy dury landing mars; Irallic lests, IDOW landing mats;		landing mat supplied by the Dow Chemical C relative to the requirement that heavy-duty duty londing (50,000-1b, simple-wheet load subgrade. Traffic tests were conducted to tests were conducted on prepared subgrades. A 50,000-1b SM, with a 250-psi tire inflations to tests were conducted on prepared subgrades. A 50,000-1b SM, with a 250-psi tire inflations to the panel designated initial production mat. This me which became at the female 1-lock corners at at 4.0 CHR. Several design modifications the panel corners. This consisted of cuttle in along the connector at an angle with with the tapered corners for a traffic test fit test, designated modified production to initial test. In the first phase of this test of traffic were applied prior to mat test soft traffic were applied prior to mat test soft traffic were applied prior to mat test soft traffic were applied to panel end joints in coverages. Aft requested that an additional coverage. Therefore, traffic was applied to joints, and the mat successfully sustained was a continuation of Phase I traffic until to the mat on a subgrade with a CBR of 3.9 Therefore, it was determined that the mat we (10h0 plus 336 coverages). Skid tests condition on wet (0.h0) and dry (0.62) surfaces feemilingent (rusway condition realing of 13 emissions).	mpany. The mat was y larving mat be cape (SNL), 250-psi tire determine the performance of the performance of the performance of the catended along the ere studied resulting the corners of the panel corners. I in an effort to import to be the performance of the panel corners. I in an effort to import the mat was placed in failure. In addition failure. In addition failure. In addition failure, and the student traffic i line of panel end an achieve 1000 covert these coverages on a tract failure at a tot (equivalent to 336 could be coveraged on the panel of the panel of the coveraged on the panel of the panel of the panel of the coveraged on the panel of the panel	traffic-tested able of sustain inflation pressumme of the tell load simulat. It has simulated to the tell load simulated to the tell load simulated to the first of coverages due to female connecting in tapering the contractor prove the performance on a subgrition to this tase 2 consisted sering tests of lane received joints be subjected as subgrade rate, all of 300 additioners on an additional subgrade rate, all of 300 additioners on an experiment of the coverages when a coverages when insulted in valuements of the of friction of	to evaluate its performance ding 1000 coverages of heavy-sure) when placed on a h-CRR russ-web mat. These traffic ing actual aircraft condition mantity of nat tested was o tire hazards caused by splitors. The subgrade was rate of the Temale connectors at coors off for approximately modified sufficient punels rusance of the mat. This transle of the mat. This trade rated at h.0 CRR and subgraffic, two miditions used for the heavy-duty landing mat). 100 percent of the trafficient of 100 percent of the trafficient of 100 percent trafficient of 100 percent at 100 percent trafficient of 100 percent at 100 percent of the trafficient of 100 percent of the trafficient of 100 percent at 100 percent of the trafficient of 100 percent at 100 percent of 100 percent of the trafficient of 100 percent at 100 percent of 1
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S. REPORT TITLE			
ENGINEER DESIGN TEST OF MODIFIED XM19 SPEC	IAL SURFACIN	G LANDING	MAT
a. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final report			
S. AUTHOR(S) (First name, middle initial, last name) Gordon L. Carr	*	7 .	
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During previous evaluations of the standard XM19 medium-duty mat, results indicated the mat would not meet the hook-impact or the cable roll-over requirements stipulated in the QMR. Inasmuch as the QMR allows a special surfacing in the cable roll-over and hook-impact areas, the standard XM19 was modified by using a thicker top skin and this mat was designated XM19 special surfacing. In conjunction with the top skin modification, the overlap and underlap edge members were changed to connectors capable of being waterproof. The mat was traffic tested with the medium-duty loading consisting of a 25,000-lb single-wheel load (SWL) on a tire inflated to 250-psi pressure. The mat supported in excess of 1600 coverages of the above loading on a subgrade strength of 4 CBR, which is 60 percent over the required coverages. The coefficients of friction of the mat surface of 0.62 dry and 0.53 wet are within the acceptable limits of 0.80 and 0.40 as specified by the QMR. The mats sustained the required 20 passes of the load cart in the same spot over a l-indiam arresting cable without fracture of the top mat surface. The blast test of 300 F for 5 sec did not cause any detrimental effects, and the mats successfully passed laboratory tests for compressive, shear, and flexural strength. The hook-impact test, consisting of two impacts on the same spot without fracture of the mat surface, was also successfully passed. The placing rate of over 500 sq ft per man-hour was in excess of the QMR requirement of 250 sq ft per man-hour essential and 400 sq ft per man-hour desired. KEYWORDS: Medium duty landing mats; Traffic tests; [XM19 landing mat]			
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CONSTRUCTION OF MESL DEMONSTRATION	N ROAD AT FORT HOOL	, TEXAS	, MAY 19/2	
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Final report			24.7	
S. AUTHOR(S) (First name, middle initial, last name)				
Steve L. Webster				
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This report records the construct	tion of a 1/2-mile	aml rane	-enveloped spil la	ran
(MESL) road constructed at Fort				
to field test MESL construction				
term evaluation. The 24-ft-wide of the Directorate of Facilities				
Clear Creek Road between Copperas	Cove Road and U. S	B. Highw	ay 190. The soil	was
a gravelly sandy clay (CL) with a	some shell. It was	encapsu	lated using 6-mil	
polycthylene as the lower membras	ne and polypropylene	a fabric	and SS-1h emulsif:	ied
asphalt as the upper membrane. (Construction of the	MESL re	quired 48 working 1	nours
and was completed in a 6-day per	iod. A surfacing of	2 in.	of hot-mix asphalt	1C
concrete was installed on the MES were constructed, and an asphalt:	ic single-surface to	eatment	was applied. The	total
materials, equipment usage, and	construction labor	east for	the MESL road with	h
asphalt surfacing was \$20,800.	The MEST, road was of	pened to	traffic in June 1	972.
A traffic count in July 1972 ind	icated an average de	rily usa	ge of 1793 vehicle:	s ,
of which 24.5 percent was truck	traffic and 75.5 per	rcent wa	s passenger car tre	illic.
KEYWORDS: Membrane envelop			ry roads; Rapid	a road
construction; [Fort Hood, Texas	5]		

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EVALUATION OF XMISQ EXTRUDED ALUMINUM LANDING MAT			
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The investigation reported herein was conducted to evaluate an extruded aluminum alloy landing mat (designated XMLSQ) supplied by the Dow Chemical Company, Madison, 111. The mat, which was fabricated by the Washington Aluminum Company (MACO), Enterprise, Ala. (Dow's subcontractor), is a one-piece extrusion fabricated from 6061 aluminum alloy artificially aged to the T6 condition. The mat panels are interlocked along the sides by means of a hinge-type connector, the components of which are an integral part of the basic panel extrusion. End connectors, composed of extruded connectors welled to the basic panel, consist of overlap and underlap sections secured by a locking bar after individual panels have been joined together. The mat mentioned herein was different from modified MMLS-B mat in that the insert tubes in the ends of the mat panels were shortened by 3/4 in. and the amount of metal was increased in the area of the female connector and first cavity adjacent to this connector. The method of attaching the end connectors to the mat extrusion was changed to allow improved welds at the corners. The investigation consisted of traffic, skid, cable roll-over, and laboratory tests to obtain information for use in evaluating the XMLSQ mat for potential use as anodium-duty landing mat. The test data reported herein were evaluated against the criteria for medium-duty mat as established in the revised Qualitative Materiel Requirement (QML). Traffic tests were conducted with the mat placed on a prepared subgrade and trafficked with a rolling wheel load simulating actual aircraft operations. The XMLSQ mat, which weighs 4.8 lb per square foot of placing area, was assembled at an average rate of 600 sq ft per man-hour. The mat's weight exceed the maximum QMR requirement for a medium-duty mat of 4.5 lb per square foot of placing area, and the placing rate exceeds the minimum QMR requirement of 250 sq ft per man-hour. The traffic tests were conducted the maximum QMR requirement for a medium-duty mat of 4.5 lb per square foo

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efforts. The latter involves that type of construction to be used when constraints are less severe but construction effort would be less than what would be termed deliberate. Procedures are provided for selection of type and quantity of stabilization based on soil type. Thickness design curves are presented for design of single- and multiple-layer pavements for both roads and airfields.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) REPORT DOCUMENTATION PAGE BEFORE COMPLETING FORM 3. RECIPIENT'S CATALOG NUMBER 1. REPORT NUMBER 2 GOVT ACCESSION NO. Miscellaneous Paper S-74-25 AD A032 944 5. TYPE OF REPORT & PENIOD COVERED 4. TITLE (and Subtitle) INVESTIGATION OF TAR-RUBBER PAVEMENT OVERLAYS Final Report 6 PERFORMING ORG. REPORT NUMBER B. CONTRACT OR GRANT NUMBER(S) 7. AUTHOR(s) Philip J. Vedros, Jr. Ralph D. Jackson 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Soils and Pavements Laboratory Project No. PREE-74-1 P. O. Box 631, Vicksburg, Miss. 39180 12. REPORT DATE 11. CONTROLLING OFFICE NAME AND ADDRESS Headquarters, U. S. Air Force November 1974 Washington, D. C. 20330 13. NUMBER OF PAGES 66 15. SECURITY CLASS. (of this report) 14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Unclassified 15a, DECLASSIFICATION DOWNGRADING SCHEDULE 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Airfields Overlays (Pavements) Rubberized-tar pavements 20. ABSTRACT (Continue on reverse side II necessary and identity by block number)

The purpose of this study was to determine why tar-rubber pavements are experiencing failures from usage by aircraft with high tire pressures. Failures are in the form of depressions and rutting, raveling of joints, and deterioration from fuel spillage. The study was accomplished by performing pavement field studies and sampling at 10 selected airfields and subjecting the tar-rubber pavement samples from these airfields to a laboratory testing program. The investigation indicated the following: (1) Performance of tar-rubber pavements

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is dependent upon the quality of construction and subsequent usage of the pavement. (2) Spillage of JP-4 fuel is more detrimental than spillage of hydraulic fluid on a short-term basis. (3) Use of heavy rubber-tired rollers appears to be necessary during construction in order to meet the density requirements. (4) Tar-rubber pavements perform poorly in all areas adjacent to refueling pits. Based on these findings the following recommendations are considered warranted: (1) Very strict quality control should be enforced during construction so that proper densities can be obtained. (2) Portland cement concrete pavements should be placed in refueling pit areas instead of tar-rubber pavements. (3) Tar-rubber pavements should not be used in aircraft parking areas where tire contact area is less than 100 sq in. and tire pressure is greater than 250 psi. (4) Better housekeeping rules should be enforced to minimize deterioration from fuel spillage.

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BEFORE COMPLETING FORM REPORT DOCUMENTATION PAGE 3. RECIPIENT'S CATALOG NUMBER I. REPORT NUMBER 2. GOVT ACCESSION NO. AD A003 168 Miscellaneous Paper S-74-27 5. TYPE OF REPORT & PERIOD COVERED 4. YITLE (and Subtitle) Final report CONDITION SURVEY, FELKER ARMY AIRFIELD, FORT EUSTIS, VIRGINIA 6. PERFORMING ORG. REPORT NUMBER 6. CONTRACT OR GRANT NUMBER(4) 7. AUTHOR(4) Ralph D. Jackson 10. PROGRAM ELEMENT PROJECT, TASK AREA & WORK UNIT NUMBERS 9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Soils and Pavements Laboratory Project No. Q6-1 P. O. Box 631, Vicksburg, Miss. 11. CONTROLLING OFFICE NAME AND ADDRESS 12. REPORT DATE November 1974 Office, Chief of Engineers, U. S. Army 13. NUMBER OF PAGES Washington, D. C. 20314 14. MONITORING AGENCY NAME & ADDRESS(il different from Controlling Office) 15. SECURITY CLASS. (of this report) Unclassified 154. DECLASSIFICATION/DOWNGRADING 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, Il different from Report) 18. SUPPLEMENTARY NOTES 19. KEY WORDS (Continue on reverse side it necessary and identify by block number) Flexible pavement performance and evaluation (Airfields) Rigid pavement performance and evaluation (Airfields) [Felker Army Airfield, Fort Eustis, Va.] 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Subsequent to publication in 1958 of the last report on the airfield pavement facilities at Felker Army Airfield, a new fixed-wing runway and other pavement facilities have been constructed. This report describes these facilities and presents a summary of the load-carrying capacities of pavement facilities at the airfield.

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This paper presents a summary of fiv		
evaluate the load-carrying capabilit were those for compression, flexure,		
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sources are presented. A combined a		
from 3640 concrete samples and the f	ollowing relati	onships were developed:
compressive strength = 10.02 (flexur	al strength) -	2123; compressive
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20. ABSTRACT (Continued):

strength = 12.53 (splitting tensile strength) - 1275; compressive strength = 9.75 (ring tensile strength) - 1786; compressive strength = 7.39 (longitudinal shear strength) - 1578; and flexural strength = 1.02 (splitting tensile strength) + 210.5. In view of the numerous factors influencing the relationships of the strengths of concrete, it is not surprising that no simple exact relation is applicable. However, these correlations are felt to be representative in lieu of specific testing for concrete pavement design and evaluation.

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REVIEW OF CONSTRUCTION EQUIPME	NT AND METHODS	Final report
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U. S. Army Engineer Waterways	DRESS	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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The investigation reported herein was conducted to review methods and equipment being used by industry in the construction of pavements and to recommend changes to Corps of Engineers guide specifications to incorporate new methods and equipment. Literature reviews were conducted, and visits were made to construction sites and equipment manufacturers. Observations and measurements were taken on pavements constructed with slip-form pavers, and a separate report was written on the results. As a result of the overall investigation, (Continued)

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20. ABSTRACT (Continued).

the pertinent golde specifications will be revised to allow the use of slipform pavers for portland cement concrete pavements in airfield construction and to add methods of testing for quality of mixture and for determining mixing times. The results of the investigation also indicate that guide specifications should be changed by eliminating requirements for specific equipment and methods and adding requirements for an end product based on methods of testing to determine the quality of the end product.

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TRUSS WEB HEAVY-DUTY LANDING MAT	1 4-1/2-11	Final report 6. PERFORMING ORG. REPORT NUMBER
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Aluminum landing mats		
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Traffic tests		
[Dow landing mats]		

The investigation reported herein was conducted to evaluate an extruded truss web aluminum alloy landing mat that is designed, extruded, and supplied by the Dow Chemical Company, Midland, Mich. The mat is a 4- by 4-1/2-ft, multihollow 6061-T6 aluminum alloy panel which consists of two 24-in.-wide extrusions welded together to form the 4-ft width. The mat has an average weight of 6.28 lb per square foot of placing area including antiskid compound.

(Continued)

20. ABSTRACT (Continued).

The panels interlock along the sides by means of a hinge-type connector, the components of which are integral parts of the panel extrusions. Short tubes matching the inside contours of the panel extrusion are inserted into each cavity and welded flush with the ends of the extrusion. Extruded end connectors are then welded to the ends of the extrusion to complete the mat panel. A symmetrical I-type end connector bar secures the end joints after individual panels have been placed together. One-half of the contracted mat quantity was fabricated by heat treating the extrusions but not aging until after the mat center weld seam was made. The remaining half of the mat was fabricated by both heat treating and aging the extrusions before any welding was done.

The 4- by 4-1/2-ft truss web mat was developed and designed to minimize the bow wave problem associated with the C-5A aircraft and also to satisfy the criteria for heavy-duty mat as established in the revised Qualitative Materiel Requirement (QMR). The investigation consisted of traffic tests to obtain information for use in evaluating the 4- by 4-1/2-ft truss web mat.

Traffic tests were conducted with the mat placed on a prepared subgrade and trafficked with a rolling wheel kead simulating actual aircraft operations. The tests were conducted with a single-wheel load of 50,000 lb with a tire inflation pressure of 250 psi on a mat-surfaced subgrade with a CBR of 3.7 for both item 1 (mat oriented with internal ribs and center weld seam perpendicular to the direction of traffic; i.e., Dow 2- by 9-ft mat standard lay pattern) and item 2 (mat oriented with internal ribs and center weld seam parallel to the direction of traffic; i.e., XM19 mat lay pattern). A row of mat movement restrictors was placed across the test section width of item 1. The test quantities of mat which were aged before and after welding were kept separate in items 1 and 2 in order to evaluate each type mat. While static deflections were being measured with the test wheel on item 2 prior to traffic, small Vshaped dimples were formed on several panels. Due to the premature failure of the panels in item 2, the mat was removed from item 2 and the individual panels were rotated 90 deg and placed in a lay pattern with the mat's internal ribs and center weld seam perpendicular to the direction of traffic. The mat was assembled at an average placing rate of 355 sq ft per man-hour for items 1 and 2, which exceeds the minimum QMR requirement of 150 sq ft per man-hour. Results of this investigation indicated that the 4- by 4-1/2-ft truss web mat on items 1 and 2 sustained 2250 and 600 actual coverages, respectively. These are equivalent to 1704 and 551 coverages on a 4-CBR subgrade for items 1 and 2, respectively. Therefore, the mat in item 1 (Dow standard lay pattern) meets the QMR 1000-coverage requirement for a heavy-duty mat on a 4-CBR subgrade. The mat movement restrictors will sustain without damage in excess of 600 coverages of the heavy-duty loading. Aging the mat either before or after welding had no significant influence on the performance of the mat.

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SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered) 20. ABSTRACT (Continued). subgrade during a 2-month period while natural and simulated rainfall of over 50 in. was recorded. No structural mat failures occurred; however, the seals leaked during the test. When removed, the seals were torn, dislodged, and distorted. For better seal performance, the seal material should be more durable and resilient. The seals should be positively attached to the mat and less susceptible to distortion.

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20. ABSTRACT (continued).

The test included both XM18 and XM19 mats. The test section was subjected to traffic with one main gear of a C-141 aircraft assembly (twin-tandem assembly) loaded to 146,000 lb. The membranes used for encapsulation of the base soil failed after about 400 coverages of the test load. However, traffic was continued until complete failure of all test items. The analysis of data obtained in this investigation indicated the following: (a) The performance of the control test item was in reasonable agreement with the existing thickness criteria. (b) The use of a high-strength MESL base under mat resulted in a reduction in thickness of the strengthening layer required between the subgrade and mat, as determined by current criteria. The indicated thickness reduction for the C-141 aircraft loading on medium-duty mat is about 25 percent. (c) The membranes used for encapsulation did not have sufficient strength to sustain the high deflections and deformation which developed under the C-141 aircraft loading for the full service life of the landing mat.

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yield the uplift force and overturning moment acting on the model. This test gave information on the effect of the landing mat connector and angle of attack on the aerodynamic characteristics of the model. The second phase consisted of subjecting a panel of M19 landing mat to the exhaust blast of a J-35 jet engine and measuring the uplift forces on the panel created by the high-velocity blast of J-35 jet engine exhaust. The uplift forces on the mat panel were measured using bolts instrumented with strain gages which anchored the test panel to the concrete surfaced test area. The results of these tests indicated that the M19 landing mat panel, when subjected to high velocities, will have imposed on it aerodynamic loads which will lift the mat panel from the ground. The mat panels need to be anchored to the ground surface along edges of runways, taxi strips, aprons, etc., where the mat may be subjected to engine blast exceeding 80 fps.

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20. ABSTRACT (Continued):

concrete are needed to ensure uniform forward movement of the paver. It is also imperative that the concrete have a uniform consistency. The construction of keys and keyways and the installation of dowels in longitudinal construction joints require special techniques. The free-standing or slipformed edges will slump to a certain extent. The magnitude of edge slump is directly proportional to slab thickness. Edge slump results in deviations of the surface from a straightedge which are greater along paving lane edges than in the interior of the paving lanes. If uncontrolled, excessive edge slump can cause problems during the construction of fill-in lanes and can result in depressions along longitudinal construction joints. Within the interior of paving lanes, the smoothness of the surface is comparable in the longitudinal and transverse directions and appears to be independent of slab thickness. Slipform pavers can be used to construct airfield pavements that are structurally and functionally adequate for aircraft operation. However, it will require a concentrated effort on the part of the engineer and the contractor to ensure that the design and specifications, field adjustments, and quality control procedures result in a pavement with the desired characteristics.

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HELICOPTER DOWNWASH PROTECTION		6. PERFORMING ORG. REPORT NUMBER
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7. AUTHOR(a)		B. CONTRACT OR GRANT NUMBER(*)
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James W. Carr		
James w. Call		
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Soils and Pavements Laboratory		Project 4A762719AT31-02
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This investigation was conducted to evaluate materials and develop construction techniques for the rapid protection of airfield and heliport shoulders and overrun areas against hot engine blast and rotor downwash with ground air velocities up to 125 mph using existing materials. The objective was accomplished by a series of jet engine exhaust blasts impinging on a number of treated test areas.

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Technical Keport Documentation Page

1. Report No	2 Government Acces	siun No 3	Recipient's Catalog N	in
FINA-RD-75-48				
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			June 1975	
A REVIEW OF ENGINEERING EX SOILS IN HIGHWAY SUBGRADES		EXPANSIVE 6.	Performing Organization	on Code
		8	Performing Organization	
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Soil Mechanics Division Soils and Pavements Labora	tory .	11	FCP 34D1-132	
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P. O. Box 631, Vicksburg,			Order No: 4-1	
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Volume change resulting fr is estimated to cause dama				
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sults of a review of curre				
of selected state highway	agencies on pr	ocedures for cop	ing with probl	ems
associated with expansive	soil subgrades	. The report dis	scusses the ge	ologic,
mineralogic, physical, and				
volume change characterist				
for sampling, identifying,				
discussed. Treatment alte				
mental volume change of ex		subgrades beneath	new and exist	ing
pavements are presented an	a aiscussea.			
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State of the art studies		<i>*</i>		
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	ION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
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Miscellaneous Paper S-75-21	AD A013 515	
I. TITLE (and Subtitle)		5. TYPE OF REPORT & PERIOD COVERED
JET BLAST TESTS ON EIBERGLASS.	PEINFORCED	Final Report
JET BLAST TESTS ON FIBERGLASS-REINFORCED DCA-1295		6. PERFORMING ORG. REPORT NUMBER
P. AUTHOR(s)		B. CONTRACT OR GRANT NUMBER(5)
Clarence R. Styron III		
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT PROJECT, TASK AREA & WORK, UNIT NUMBERS
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9. KEY WORDS (Continue on reverse side if necess) Dust control Fiber reinforced plastics Jet blast resistant materia Materials O. ABSTRACT (Continue on reverse side if necess) This report describes an effor of DCA-1295 reinforced with fi	ency and identify by black number) [C-5A a: als ery and identify by black number) t to evaluate a dust berglass scrim when s in the range of the to clay panels were to tim and found to with recommended that the	-control system consisting subjected to jet blast tests ose caused by operating C-5 reated with DCA-1295 and stand air blast velocities dust-control system be test

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Miscellaneous Paper S-75-23	AD A016 854	
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EVALUATION OF A NUCLEAR ASPHAL	T CONTENT GAGE	Final report
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. AUTHOR(a)		8. CONTRACT OR GRANT NUMBER(#)
George L. Regan		
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P. O. Box 631, Vicksburg, Miss 1. CONTROLLING OFFICE NAME AND ADDRESS	. 34100	Work Unit 302
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20. ABSTRACT (Continued).

These included 2ⁿ factorial experiments and stepwise multiple linear regression analyses of the results. Asphalt content determinations equaling or bettering those of the conventional extraction technique were obtained in considerably less time.

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REPORT DOCUMENTATION F	PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
Miscellaneous Paper M-76-1	AD A021 652	3. RECIPIENT'S CATALOG NUMBER
A. TITLE (and Subtilie) PRELIMINARY TESTS OF GLOSS-REDUCTION AND COLORING AGENTS FOR CAMOUFLAGE OF POLYVINYL ACETATE DUST-CONTROL FILM 7. AUTHOR(*) Clarence R. Styron III Eugene E. Addor		S. TYPE OF REPORT & PERIOD COVERED Final report 6. PERFORMING ORG. REPORT NUMBER
		8. CONTRACT OR GRANT NUMBER(*)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Mobility and Environmental Systems Laboratory P. O. Box 631, Vicksburg, Miss. 39180		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Project 1A762719AT40, Task A3, Work Unit 1006 (former 4A762719AT33)
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse elde if necessary and identify by block number)

Camouflage Materials

Coloring agents Polyvinyl acetate

Dust control Gloss reduction

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

DCA-1295 is a special polyvinyl acetate (PVA) formulation developed for the U.S. Department of the Army for use as a dust-control surface on expedient airstrips and adjacent service areas. The PVA is sprayed over a fiberglass scrim to form a thin film over the ground surface, and has been field tested and proven effective for its design purpose. However, the PVA film cures to a glossy, highly reflective surface that can be easily detected by enemy surveillance systems, is potentially highly attractive to target-seeking missile guidance devices, and sometimes creates hazardous visibility (Continued)

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20. ABSTRACT (Continued)

conditions for aircraft landings. The purpose of the work reported herein was to search for possible means for reducing the glossiness of the cured PVA surface, with the possibility for adding camouflage coloration also considered. A formula was found for mixing colored chalk dust (marking chalk powder) with DCA-1295 concentrate to produce an emulsion that can be painted (brushed, rolled, or sprayed) on the cured, in-place PVA film, and that cures to a tough, nonglossy, colored surface. This formulation formed a good bond with the cured film, and in a field test withstood direct sun and weather for 11 months, well beyond the 6-month design life of the film. In addition, this formulation was also applied, with satisfactory results, to a cured DCA-1295 film (without the fiberglass reinforcement) previously spray-coated onto metal landing mat and fiber membrane. None of the experimental substances (various paint flatteners and extenders, dyes, flat latex paint, and coloring powders) produced satisfactory results when admixed directly with the DCA-1295 emulsion for direct application to the fiberglass scrim during initial installation. It is recommended that the comouflage potential of chalk-dust PVA coating be further evaluated, including its effect on infrared and radar signatures, with particular emphasis on its potential use as a camouflage coating for fixed installations. It is also recommended that research be initiated toward developing a chemically compatible deglossing and coloring agent for inclusion in the DCA-1295 emulsion at its initial application.

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Miscellaneous Paper M-76-18	AD B014 711L	
. TITLE (and Sublitle)		5. TYPE OF REPORT & PERIOD COVERED
PRELIMINARY EVALUATION OF THE ABILITY OF THE C-12A AIRCRAFT TO OPERATE SAFELY ON SUBSTANDARD AIRSTRIPS		Final report
		6. PERFORMING ORG. REPORT NUMBER
AUTHOR()		8. CONTRACT OR GRANT NUMBER(*)
Gary N. Durham		
Newell R. Murphy, Jr.		
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19. KEY WORDS (Continue on reverse elde if necessary and identity by block number)

Aircraft landing areas
Mathematical models
Surface roughness (Pavements)
Ride dynamics

20. ABSTRACT (Continue on reverse side # necessary and identify by block number)

This report describes the results provided to the U. S. Aviation Systems Command (AVSCOM) by the U. S. Army Engineer Waterways Experiment Station in support of a program to evaluate the ability of the C-12A aircraft to operate safely on substandard airstrips. Platform-drop and discrete-obstacle tests were conducted with an instrumented C-12A aircraft to determine critical resonances and spring and damping rates for inputs to a mathematical model. The model, which is a modified version of one currently used to describe the (Continued)

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[Edwards Air Force Base, California]

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20. ABSTRACT (Continued)

kinematics of ground vehicles, is proposed to be used in a later phase of the program as an evaluation tool. Its prediction accuracy was checked by comparing results of simulated and actual drop tests. There are deviations between the measured and predicted responses, but they are not considered to be of major importance. It is noted that certain deficiencies will have to be addressed and an extensive sensitivity analysis made before the model can be used to suitably represent aircraft operations.

Data obtained at four airstrips in the vicinity of Edwards AFB, California, permit a characterization of the strips in the quantitative terms necessary for suitable relations of aircraft response. The airstrips are characterized in terms of Fourier spectra, rms roughness levels, and bump-height distributions. Airfield cone index is used to evaluate soil strength.

A test plan is recommended to evaluate the aircraft's ability to negotiate discrete obstacles and to operate on various substandard airstrips. The plan consists of a series of tests on four specified obstacle configurations designed to excite various components of the aircraft. The test sequence on each tacle configuration is designed to begin at low response levels and propositively increase in intensity until one of the aircraft's critical components accordes 80 percent of its design limit. This requires continuous monitoring of the dynamic responses during testing.

A sequence of landing, takeoff and taxi tests is planned for the four substandard airstrips that will allow an evaluation of aircraft responses as a function of speed and surface roughness. The results of these performance tests should provide the data from which an empirical method for forecasting safe operations of the aircraft can be developed.

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VIBRATORY COMPACTION OF BITUMINOUS CONCRETE PAVEMENTS		Final report
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7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(*)
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Bituminous concretes Flexible pavements Hot mix

Rubberized tar Vibratory compaction Vibratory compactors

Overlays (Pavements)

20. ABSTRACT (Continue on reverse eide if necessary and identity by block number)

This study was conducted to evaluate the effectiveness of vibratory rollers in the compaction of hot-mix asphaltic concrete and rubberized-tar concrete to satisfy the needs of the Air Force. The study consisted of overlaying an existing heavy gear load test section at the U. S. Army Engineer Waterways Experiment Station, which consisted of rigid and flexible pavements, with asphaltic concrete and rubberized-tar concrete pavements. The overlay

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20. ABSTRACT (Continued).

pavements were compacted with two selected vibratory rollers, a Buffalo-Bomag BW210-A and a Dynapac CC-50A. A conventional steel-wheeled static roller and a pneumatic-tired static roller were also used for comparison. Variables included in the study were roller weight, frequency and amplitude of vibration, number of roller passes, type of roller (vibratory or static), type of foundation, and type and thickness of overlay pavements. The significant findings from this study are that (a) vibratory rollers of the type used are satisfactory for the compaction of high-quality bituminous concrete pavements, and (b) if properly used, they can provide densities meeting the requirements of the Air Force and the Corps of Engineers.

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Also published as FAA Report No. FAA-RD-74-38.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Construction control
Design standards
Flexible pavements
Seal coats

This report presents the results of a field performance survey first described in Report No. FAA-RD-73-197. Additional prototype construction experience and validation of a design procedure including a desired mixing viscosity range are reported. Long-term porous friction course (PFC) performance is recorded and combined with laboratory test results that provide data for a new recommended PFC relation, water permeability requirements, and initial voids total mix

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INVESTIGATION OF FABRICS AND BITUMINOUS SURFACES FOR USE IN MESL CONSTRUCTION		Final report
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Fabrics		
Liquid asphalt		
Membrane enveloped soil layer		
Membranes 20. ABSTRACT (Continue on reverse side II necessary and The objectives of this study	were to develop	and test new waterproof
membranes and pavement surfacings for membrane-enveloped soil layers (MESL) and to establish design criteria for their use. Three separate test series		
were conducted at the Waterways Ex		
facility. Various test items cont		
containing MESL with different pay was applied using a load cart equi	rement surfacings	were tested. Test traffic tary truck, dual-wheel
		(Continued)

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20. ABSTRACT (Continued).

assembly loaded to simulate an 18-kip axle load. Test results showed that both cationic and anionic emulsified asphalts are suitable for use in upper membranes for MESL. However, the rapid- and medium-curing grades of cutback asphalts are not suitable. Several nonwoven fabrics were found suitable for use with emulsified asphalt for constructing wearing membranes for MESL. Design criteria regarding membranes and wearing surfaces are offered.

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Eugene C. Odom		
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20. ABSTRACT (Continued).

mood condition. Although the junctures have performed generally well, the asphaltic concrete pavement portions have experienced some minor problems (namely, humping, transverse cracking, and surface depressions). From the problems aspeciated with the junctures studied, it is recommended that the present design be revised slightly. A recommended revision of the design of rigid-flexible airfield pavement junctures is described. The revision involves use of expansion joints, increased thickness of the asphaltic concrete, and special rolling procedures for the asphaltic concrete binder and surface courses.

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Carlton L. Rone	
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Fuel spillage (Pavements)
Jet fuel resistant materials
[Salviacim pavement]

20. ABSTRACT (Continue on reverse side if necessary and identity by block number)

This investigation was conducted to evaluate the effectiveness of a special pavement surfacing material called Salviacim to resist the detrimental effects of fuel and oil spillage and scuffing from maneuvering of tracked-type vehicles. Salviacim pavement consists of an open-graded (18 to 25 percent voids total mixture) asphaltic concrete base mat with Salviacim grout spread on the surface and vibrated into the voids with a light vibratory roller. Salviacim is a proprietary material developed in France and has been used in Europe, South (continued)

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20. ABSTRACT (continued).

Africa, Japan, and other places with apparent good success. Material was purchased from the H. F. Campbell Company, Detroit, Mich., the distributor of this material in the United States. A test section was constructed in accordance with instructions furnished by the H. F. Campbell Company and subjected to fuel and oil spillage tests and maneuvering of tracked-type vehicles. The test section was subjected to spillage of JP-4 fuel and a synthetic-base aircraft turbine engine lubricating oil. Tracked-type vehicles used for maneuvering were an M56 mobile gun, an M13 armored personnel carrier, and an M48Al tank. The Salviacim pavement developed cracks during curing that were penetrated by the fuel and oil which softened the asphaltic concrete binder and caused the pavement to lose stability. The results of this study indicate the surfacing is not as resistant to maneuvering of tracked-type vehicles as a dense-graded, well-compacted asphaltic concrete.

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Soils and Pavements Laboratory		
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Rigid pavement performance and ev	valuation (Airfie	elds)
[Butts Army Airfield, Fort Carson, Colorado]		
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The purpose of this report is to		evaluation report (October
1960) that was prepared for this		
field in-place tests requested by		
performed by the Lincoln DeVore Testing Laboratory of Colorado Springs. An		
inspection of the condition of the pavement was made by U. S. Army Engineer		
Waterways Experiment Station person	onnel on 6 Novemb	per 1975.

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SKID TESTS ON XM18, XM19, AND TIL LANDING MATS PLACED IN CONTACT WITH SOIL AND PLACED ON MEMBRANE ON SOIL		Final report 6. PERFORMING ORG. REPORT NUMBER
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Anchors (Fasteners) Coatings	Skid resistanc Skid tests	е
Landing mats	[T11 landing m	atl
Membranes Nonskid compounds	XM18 landing XM19 landing	mat]

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Tests were performed on landing mats and membranes to evaluate the antiskid properties of paints and antiskid coating when each was in contact with a loaded rubber tire, and/or when each was in contact with soil or membrane. The data were used to determine the forces which were transmitted through the mats to the underlying materials and which the anchors would have to resist to prevent mat movement under a braking aircraft tire. Panels with antiskid on both sides increased the resistance of panels to sliding along the (Continued)

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data indicated that the ancho	the forces transmitted to the mat anchors. Test rs would have to resist greater forces produced mats were placed on membrane than when the mats

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2. GOVT ACCESSION NO. 3. RECIPIENT'S CATALOG NUMBER REPORT DOCUMENTATION PAGE Miscellaneous Paper S-76-24 AD A033 914 5. TYPE OF REPORT & PERIOD COVERED 4. TITLE (and Subtitle) USAGE OF LANDING MAT AS OVERLAY OH ASPHALT Final Report RUNWAY DURING MILITARY FIELD EXERCISES 6. PERFORMING ORG. REPORT NUMBER B. CONTHACT OR GRANT NUMBER(*) 7. AUTHOR(N) Hugh L. Green 9. PERFORMING ORGANIZATION NAME AND ADDRESS 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS U. S. Army Engineer Waterways Experiment Station Project No. 17162112A528. Soils and Pavements Laboratory P. O. Box 631, Vicksburg, Miss. Task 04 12. REPORT DATE 11. CONTROLLING OFFICE HAME AND ADDRESS December 1976 U. S. Army Materiel Development and Readiness 13. NUMBER OF PAGES Command Alexandria, Va. 22333 14. MONITORING AGENCY HAME & ADDRESS(If different from Controlling Office) 15. SECURITY CLASS. (of this report) Unclassified 15%. DECLASSIFICATION/DOWNGRADING SCHEDULE 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES 19. KEY WORDS (Continue on reverse side II necessary and identify by block number) Plexible pavements Landing mats Landing strips Membranes (Airfields) Overlays (Landing mats) 20. ABSTRACT (Continue on roverse side if necessary and identify by block number) This report describes four military exercises conducted at Oak Grove, N. C., in which XM18 landing mat was placed over a deteriorating amphalt runway to provide a landing strip for C-130 cargo aircraft. In the past, studies had been conducted at the WES on this subject; however, this was the first opportunity to gain firsthand knowledge on the behavior of the aircraft and the landing mat during a field exercise. This report is based on Memorandums for Record (MFR's prepared for each of the exercises, which were conducted over a four-year period. Details of each exercise are described in the MFR's, which (

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20. Abstract (Continued).

are presented in their entirety as appendixes in this report. The lessons learned that may be helpful in future installations of landing mat over asphalt are listed in the form of conclusions and recommendations. It is concluded that (a) the use of landing mats over an existing deteriorating asphaltic pavement will upgrade the pavement, and prevent foreign object damage to aircraft from occurring; (b) if there are no major potholes or "birdbaths" in the runway that would cause mat bridging, it is not necessary to place a leveling course of sand between the mat and the pavement; (c) if the deteriorated condition and roughness of the field dictate that a leveling soil course is required, a lightweight membrane should be placed between the soil and the landing mat to prevent pumping of the soil at the mat joints during inclement weather; and (d) planktype landing mat, such as the XM18, can sustain horizontal movement in the direction of aircraft landings in the magnitude of approximately 25 in. without structural mat damage or adverse effects to the runway complex; however, based on similar exercises, a detrimental bow wave may develop if joints become tightly closed and this should be closely observed and avoided. This report should prove to be a valuable aid to a unit commander responsible for installation of landing mat over asphalt pavement.